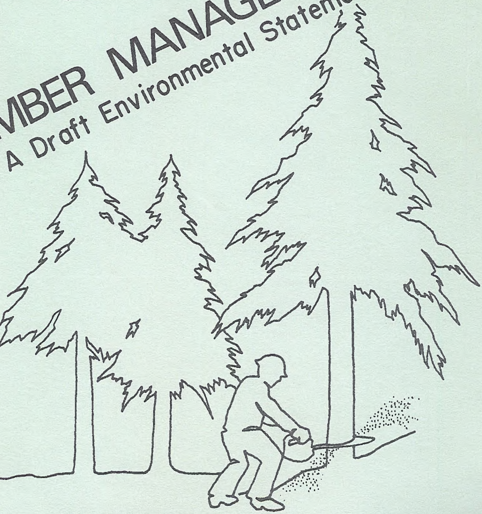
BLM LIBRARY
88045485

TIMBER MANAGEMENT

A Draft Environmental Statement



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
JANUARY, 1975

No Comme

Bureau of Land Management
Library
Denver Service Center

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

ID88045485

SD
538.2
.A17
T58
1975

SUMMARY

(X) Draft ( ) Final Environmental Statement

Department of the Interior, Bureau of Land Management

1. Type of Action:

(X) Administrative ( ) Legislative

2. Brief Description of Action:

This statement addresses itself to the current 10 year timber management program carried out under the principles of sustained-yield and multiple use on 23 million acres of forest land in the Western United States. No major changes in the current program are proposed. Since the nature of the timber management program varies considerably between three geographic areas they are described individually as follows:

a. Western Oregon. The 1.9 million acres available for timber production are located in the Coast Range and the western approaches to the Cascade Mountains and represent some of the most productive and intensively managed forests in the United States. These lands have an annual allowable cut of 1.172 billion board feet.

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

Bureau of Land Management
Library
Denver Service Center

The program includes the harvest of mature timber, road construction, salvage of dead trees, precommercial thinning of unmarketable trees, commercial thinning of marketable trees, testing of fertilization, site preparation and reforestation, prescribed burning of debris, brush and hardwood control by mechanical and chemical means, protection from insects, disease and fire, conversion of hardwood stands presently occupying conifer sites and the genetic improvement of trees.

b. Arizona, California, Colorado, Idaho, Montana, New Mexico, eastern Oregon, South Dakota, Utah, Washington and Wyoming. The 1.6 million acres available for timber production are scattered throughout the foregoing states and are under a moderate level of program intensity. These lands are generally in a low productivity class with an annual cut of 148 million board feet. The program includes the harvest of mature timber, road construction, site preparation and reforestation, protection from insects, disease and fire and precommercial and commercial thinning. Besides fewer practices being carried out on these lands than in western Oregon the extent to which practices common to both are carried out is considerably less.

c. Interior Alaska. The 19.5 million acres of commercial forest have a potential estimated annual allowable cut of 72 million board feet. However, due to the economic inaccessibility of these forests the timber management program is essentially limited to fire protection.

3. Summary of Adverse Environmental Effects Following Mitigation:

a. Aesthetics and Human Interest - Clearcutting, heavy partial cutting, road cuts and fills and occasional massive soil movements will detract from the natural appearance of the forest. The smell, sound, smoke and dust associated with timber operations will have an adverse effect on the senses of most forest visitors. The replacement of old growth stands with young growth stands will adversely impact the aesthetic values of the environment perceived by some segments of the public. Because it is often difficult to locate or recognize some archeological sites, an occasional site may sometimes be inadvertenly destroyed.

b. Air - Smoke from the prescribed burning of forest debris will sometimes constitute a minor temporary nuisance to human inhabitants. Extensive smoke from any wildfires caused by timber management practices could conceivably result in injuries or deaths.

c. Ecological Interrelationships - Most practices will alter the appearance of the forest and temporarily disrupt the balanced relationship between its basic components, particularly those practices that involve vegetal destruction or removal, and soil movement. These practices will alter the seral stage or development that a given biological community is in; the extent of which will be in relation to the geography and acreage involved.

d. Recreation - Natural waters which provide fishing, boating and swimming opportunities will be occasionally muddied or invaded by debris carried downslope from logged areas. Any general recreational use of specific areas will be temporarily disrupted during the period that timber operations are carried out on the area.

e. Soil - Practices such as cutting, logging and fire line construction will result in localized soil erosion, compaction and occasional mass movements. Of any practice, road construction will have the greatest adverse effect on soil stability.

f. Vegetation - The natural succession of forest vegetation from pioneer to climax species will be interrupted, and in most instances forestalled, due to harvesting and reforestation practices.

g. Water - Surface runoff on disturbed areas will accelerate to a minor degree the natural rate of eutrophication of water bodies. Sedimentation, resulting primarily from road construction practices, will temporarily degrade water quality. Water temperatures of small tributary streams will be raised temporarily by forest canopy removal. Any accidential entry of chemical toxicants into water bodies can result in severe degradation of water quality with resultant adverse impacts on aquatic life.

h. Wilderness Experience - Timber management practices will destroy any wilderness or pristine-type values associated with undeveloped areas.

i. Wildlife - Short-term disruptions of the aquatic habitat and subsequent death or damage to aquatic wildlife will occur infrequently as a result of accidental stream blockages, high water temperatures, and sedimentation. Some individual terrestrial animals will be killed or displaced along with the destruction of their habitat by such activities as scarification, chemical weed control, cutting, logging and road construction. Displacement of wildlife will result in temporary reductions in populations in those instances where the adjacent lands are at full carrying capacity.

4. Alternatives Considered:

   a. No timber management program.
   b. Limited timber management program.
   c. Other timber harvesting practices.
   d. Other domestic sources of timber.
   e. Foreign imports.
   f. Substitute materials.

5. Comments Have Been Requested from the Following:

   (See Enclosed List.)

6. Date Draft Statement Made Available to CEQ:

Comments Requested from the Following

Federal Agencies:

- Environmental Protection Agency
- Department of Agriculture
- Department of Health, Education and Welfare
- Department of Transportation
- Department of Defense
- Department of Commerce
- Department of Housing and Urban Development
- Department of the Interior
  - Bureau of Land Management
  - Bureau of Outdoor Recreation
  - National Park Service
  - Bureau of Indian Affairs
  - Bureau of Reclamation
  - Fish and Wildlife Service
  - Geological Survey
  - Bureau of Mines

State Agencies:

Department of Conservation, California, Department of Natural Resources and Conservation, Montana, Department of Environmental Quality, Oregon, Oregon State Department of Forestry, State Forestry Division, Wyoming, Department of Natural Resources, Washington, Department of Natural Resources, Alaska, Colorado State Forest Service, and Idaho Department of Public Lands.

DEPARTMENT OF THE INTERIOR

DRAFT
ENVIRONMENTAL STATEMENT

FOR
TIMBER MANAGEMENT

PREPARED BY

BUREAU OF LAND MANAGEMENT
DEPARTMENT OF THE INTERIOR

Curt Berklund
Director

TABLE OF CONTENTS

Page

INTRODUCTION 1

I. TIMBER MANAGEMENT (PROPOSED ACTION) I-1

- A. Description of the Program I-1
- B. Forest Management Objectives and Policies I-13
- C. Forest Land Use Planning Procedures I-16
- D. Timber Management Objectives, Policies, Procedures and Regulations I-20
- E. Operational Practices I-27
  - 1. Development I-30
    - a. Tree Improvement I-31
    - b. Scarification I-31
    - c. Mechanical Brush Cutting I-32
    - d. Mechanical Trenching-Furrowing I-32
    - e. Area Burning I-32
    - f. Spot Burning I-32
    - g. Burying I-33
    - h. Chipping I-33
    - i. Hand Clearing and Cleaning I-33
    - j. Seeding I-33
    - k. Planting I-34
    - l. Chemical Weed Control I-35

Page

m. Baiting I-35

n. Fencing and Screening I-35

o. Mulching I-36

p. Snag Felling I-36

q. Fertilization I-36

r. Precommercial Thinning I-37

s. Pruning I-38

t. Stand Conversion I-38

u. Brush-Hardwood Control I-38

2. Protection I-39

a. Fire Control I-39

b. Insect Control I-40

c. Disease Control I-44

3. Harvest I-46

a. Cutting Practices I-47

b. Logging Systems I-51

c. Transportation Systems I-60

F. History of the Public Lands I-67

G. History of Organizational Structure I-73

H. History of the Timber Management Program I-75

I. Interrelationships With Other Programs I-76

Bibliography I-80

II. DESCRIPTION OF THE ENVIRONMENT II-1

A. Geographic Location II-1

B. Ecological Interrelationships II-4

1. General Physical Environment II-4

2. General Biotic Community II-5

Page

3. Coniferous Forest Biome Ecosystem II-6
    - a. Nutrient Cycle II-7
    - b. Energy Flow II-8
    - c. Hydrologic Cycle II-9

C. Physiography and Geology II-12

1. Montane and Northwest Coastal Coniferous Forest II-15
    - a. Interior Plains II-15
    - b. Rocky Mountains System II-16
    - c. Intermontane Plateaus II-18
    - d. Pacific Mountains System II-20

2. Taiga and Northwest Coastal Coniferous Forests II-23
    - a. Interior Plains II-23
    - b. Rocky Mountains System II-24
    - c. Intermontane Plateaus II-24
    - d. Pacific Mountains System II-26

D. Minerals II-28

1. Montane Coniferous Forest and Northwest Coastal Coniferous Forest (Excluding Alaska) II-28

2. Taiga Coniferous Forest and Northwest Coastal Coniferous Forest (Alaska) II-30

E. Soils II-30

1. Northwest Coastal, Taiga and Montane Coniferous Forest II-36

2. Taiga Coniferous Forest II-37

3. Montane Coniferous Forest II-37

Page

F. Water II-38
  1. Surface Water II-39
  2. Groundwater II-45
G. Climate and Air II-47
  1. Northwest Coastal Coniferous Forest II-50
  2. Montane Coniferous Forest II-51
  3. Taiga Coniferous Forest II-56
H. Vegetation II-58
  1. Terrestrial Vegetation II-58
    a. Taiga Coniferous Forest II-59
    b. Northwest Coastal Forest II-61
    c. Montane Coniferous Forest II-65
  2. Aquatic Vegetation II-74
I. Animals II-78
  1. Wildlife-Terrestrial II-78
    a. The Northwest Coastal Forest II-80
    b. Montane Coniferous Forest II-82
    c. Taiga Coniferous Forest II-85
  2. Wildlife-Aquatic II-86
    a. Northwest Coastal Coniferous Forest II-89
    b. Taiga Coniferous Forest II-91
    c. Montane Coniferous Forest II-92
  3. Domestic Livestock II-93
J. Micro and Macro-Organisms II-94

Page

1. Soil Organisms II-94
2. Aquatic Organisms II-96

K. Human Settlement and Land Use II-97
1. Montane Coniferous Forest II-97
2. Northwest Coastal Coniferous Forest II-102
3. Taiga Coniferous Forest II-109

L. Aesthetics and Human Interest Values II-112
1. Aesthetics II-112
2. Geological Human Interest II-113
3. Archeological Human Interest II-114
4. Historical Human Interest II-115
5. Cultural, Ethnic and Religious Human Interest II-116

Bibliography II-118

III. ENVIRONMENTAL IMPACTS OF TIMBER MANAGEMENT III-1

A. Summary of Environmental Impacts of the Program III-1

B. Environmental Impacts of Timber Management Practices III-16
1. Ecological Interrelationships III-18
2. Physiography, Geology and Minerals III-22
3. Soils III-26
4. Water III-33
5. Air and Microclimate III-47
6. Vegetation III-52
   a. Terrestrial III-52
   b. Aquatic Vegetation III-59
7. Animals III-62
   a. Wildlife-Terrestrial III-62

Page

b. Wildlife-Aquatic III-70

c. Domestic Livestock III-77

8. Micro and Macro-Organisms III-80

a. Soil Organisms III-80

b. Aquatic Organisms III-82

9. Human Settlement and Land Use III-85

a. Human Settlement III-86

(1) Health and Safety III-86

(2) Employment III-87

(3) Local and Regional Economies III-88

b. Mineral Development III-88

c. Wilderness III-88

d. Recreation III-89

e. Grazing III-90

f. Agriculture III-91

g. Commercial, Residential and Industrial III-92

h. Local Government and Public Services III-93

10. Aesthetics and Human Interest III-93

a. Aesthetics III-93

(1) Visual Impacts III-93

(2) Sound, Odor and Mood III-95

b. Geological Human Interest Values III-96

c. Archeological Human Interest Values III-96

d. Historical Human Interest Values III-97

e. Cultural, Ethnic and Religious Values III-97

Page

11. Wildfire III-98

Bibliography III-100

IV. MITIGATIVE MEASURES TO BE FOLLOWED IN TIMBER MANAGEMENT IV-1

A. Ecological Interrelationships IV-2

B. Physiography, Geology and Minerals IV-3

C. Soils IV-5

D. Water IV-16

E. Air and Microclimate IV-26

F. Vegetation IV-28

1. Terrestrial Vegetation IV-28

2. Aquatic Vegetation IV-32

G. Animals IV-34

1. Terrestrial Wildlife IV-34

2. Aquatic Wildlife IV-37

3. Domestic Livestock IV-42

H. Micro and Macro-Organisms IV-43

1. Soil Organisms IV-43

2. Aquatic Organisms IV-43

I. Human Settlement and Land Use IV-45

1. Human Settlement IV-46

2. Mineral Development IV-46

3. Wilderness IV-46

4. Recreation IV-46

5. Grazing IV-49

Page

6. Agriculture IV-49

7. Commercial, Residential and Industrial IV-49

8. Local Government and Public Service IV-50

J. Aesthetics and Human Interest IV-50

1. Aesthetics IV-50

a. Visual Impacts IV-50

b. Sound, Odor and Mood IV-52

2. Geologic Human Interest Values IV-53

3. Archeological Human Interest Values IV-53

4. Historical Human Interest Values IV-53

5. Cultural, Ethnic and Religious IV-53

K. Wildfire IV-54

Bibliography IV-55

V. ADVERSE IMPACTS THAT CANNOT BE AVOIDED DESPITE MITIGATION V-1

A. Ecological Interrelationships V-2

B. Physiography, Geology and Minerals V-3

C. Soils V-3

D. Water V-4

E. Air and Microclimate V-6

F. Vegetation V-7

1. Terrestrial Vegetation V-7

2. Aquatic Vegetation V-8

G. Animals V-8

1. Terrestrial Wildlife V-8

2. Aquatic Wildlife V-9

3. Domestic Livestock V-9

Page

H. Micro and Macro-Organisms V-9
  1. Soil Organisms V-9
  2. Aquatic Organisms V-9
I. Human Settlement and Land Use V-10
  1. Human Settlement V-10
  2. Mineral Development V-10
  3. Wilderness V-10
  4. Recreation V-10
  5. Grazing V-11
  6. Agriculture V-11
  7. Commercial, Residential and Industrial V-11
  8. Local Government and Public Service V-11
J. Aesthetics and Human Interest V-11
  1. Aesthetics V-11
  2. Geologic Human Interest Values V-12
  3. Archeologic Human Interest Values V-12
  4. Historical Human Interest Values V-12
  5. Cultural, Ethnic and Religious Values V-12
K. Wildfire V-13
Bibliography
VI. SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY VI-1
A. Ecological Interrelationships VI-2
B. Physiography, Geology and Minerals VI-2
C. Soils VI-2
D. Water VI-3
E. Air and Microclimate VI-3

Page

F. Vegetation VI-4
  1. Terrestrial Vegetation VI-4
  2. Aquatic Vegetation VI-4
G. Animals VI-5
  1. Terrestrial Wildlife VI-5
  2. Aquatic Wildlife VI-5
  3. Domestic Livestock VI-5
H. Micro and Macro-Organisms VI-6
  1. Soil Organisms VI-6
  2. Aquatic Organisms VI-6
I. Human Settlement and Land Use VI-6
  1. Health and Safety VI-6
  2. Mineral Development VI-6
  3. Wilderness VI-6
  4. Recreation VI-7
  5. Grazing VI-7
  6. Agriculture VI-7
  7. Commercial, Residential and Industrial VI-7
  8. Local Government and Public Service VI-7
J. Aesthetics and Human Interest VI-7
  1. Aesthetics VI-7
  2. Geologic Human Interest Values VI-8
  3. Archeologic Human Interest Values VI-8
  4. Historic Human Interest Values VI-8
  5. Cultural, Ethnic and Religious Values VI-8
K. Wildfire VI-9

Page

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES VII-1

- A. Ecological Interrelationships VII-1
- B. Physiography, Geology and Minerals VII-2
- C. Soils VII-2
- D. Water VII-3
- E. Air and Microclimate VII-3
- F. Vegetation VII-3
  - 1. Terrestrial Vegetation VII-3
  - 2. Aquatic Vegetation VII-4
- G. Animals VII-4
  - 1. Terrestrial Wildlife VII-4
  - 2. Aquatic Wildlife VII-4
  - 3. Domestic Livestock VII-5
- H. Micro and Macro-Organisms VII-5
  - 1. Soil Organisms VII-5
  - 2. Aquatic Organisms VII-5
- I. Human Settlement and Land Use VII-5
  - 1. Health and Safety VII-5
  - 2. Mineral Development VII-6
  - 3. Wilderness VII-6
  - 4. Recreation VII-6
  - 5. Grazing VII-6
  - 6. Agriculture VII-6
  - 7. Residential, Commercial and Industrial VII-7
  - 8. Local Government and Public Services VII-7

Page

J. Aesthetics and Human Interest VII-7

1. Aesthetics VII-7

2. Geological Human Interest Values VII-7

3. Archeologic Human Interest Values VII-7

4. Historical Human Interest Values VII-8

5. Cultural, Ethnic and Religious Values VII-8

K. Wildfire VII-8

VIII. ALTERNATIVES VIII-1

A. No-Timber Management Program VIII-1

B. Limited Timber Management Program VIII-12

C. Other Timber Harvesting Practices VIII-28

D. Other Domestic Wood Production VIII-38

E. Wood Imports VIII-41

F. Substitute Materials VIII-43

Bibliography VIII-46

IX. CONSULTATION AND COORDINATION WITH OTHERS IX-1

X. APPENDIX

A. BLM Manual 5424, "Preparation of Contracts and Exhibits"

B. Sample Timber Sale Contract

C. Revested Oregon and California Railroad and Reconveyed Coos Bay Wagon Road Grant Lands Act of 1937

INTRODUCTION

This environmental impact statement has been prepared pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969. It is a statement describing, evaluating, and discussing the environmental impacts of the actions associated with the current national timber management program carried out by the Bureau of Land Management on the forested lands under its administration.

Objectives:

1. To provide a basic and general description of timber management practices and a evaluation of their individual, combined and cumulative environmental impacts on a program wide basis and the measures to be followed for their mitigation.

2. To serve as the foundation and framework for subsequent environmental analyses and statements which may be required for a timber management program on a state, district or individual forest basis. It will identify factors needing close attention in such analyses as well as areas needing further study for definitive information prior to taking action. It will further serve as a reference in the preparation of environmental analyses which are required for all timber sales and projects and in the preparation of environmental impact statements when required.

3. To provide the public and Bureau personnel with information to be used in evaluating alternative actions in terms of potential environmental impacts in the course of forest land use planning and timber management program development.

4. To serve as a single comprehensive document that describes the history, objectives, policies, procedures, operational practices and natural resources associated with the Bureau's timber management program.

Scope:

The actions described in this environmental impact statement includes all development, protection, harvest and transportation practices carried out for the purpose of producing raw material to help meet the nation's wood product needs. Certain of these practices, such as road construction or protection may be viewed as necessary regardless of actual forest land use; however they are included and described in the context of timber management.

While timber management only represents one component of the Bureau's total forest management effort, this statement does not explicitly address itself to those practices or actions which are carried out for the specific purpose of producing or providing other forest values and uses on the public lands. Recreation, aesthetics, minerals, wildlife, watershed, range and other forest resource values are only described in terms of how they are impacted by timber management practices. To date draft programmatic environmental impact statements for livestock management and coal leasing have been issued for public review. In addition, draft environmental impact statements are currently being prepared for the following activities which are partially timber management related: chemical toxicants; chemical pesticides; pesticide container disposal; and fire management.

This statement is limited to the ecological impact of the actions which originate or occur on public lands. Thus, the environmental impact of the subsequent off-site processing of the raw material is not discussed. Finally, the statement does not address itself to woodlands, including pinyon-juniper, since these lands usually support open-grown, widely scattered trees of marginal merchantability not currently subject to commercial timber production.

I. TIMBER MANAGEMENT (PROPOSED ACTION)

A. Description of the Program

The Bureau of Land Management administers approximately 23 million acres of commercial forest land in the Western United States under the principles of sustained-yield and multiple-use. These forests represent 4.5 percent of the total forest area in the U.S. and support 88 billion board feet (Scribner Log Rule) of merchantable timber or 2 percent of the nation's wood supply. While all of these lands have the biological potential for producing commercial crops of timber the current program is essentially restricted to 3.5 million acres due to economic, social and environmental factors. Based on the current 10 year program the production from these lands is 1.3 billion board feet annually, representing approximately 3 percent of the nation's total annual wood production. The value of the timber sold in 1973 was $131 million and more recently $215 million in 1974. The cost of carrying out the program is approximately $20 million annually.

The predominant species harvested is Douglas-fir. Other species harvested include western hemlock, ponderosa pine, sugar pine and western red cedar. Since over half of the forests are composed of overmature trees the preponderance of the timber harvested is in the form of old growth i.e., trees 200 years in age and older. At the current rate of harvest on lands available for timber production approximately 25 years of cutting remains in the old growth forests of western Oregon and 40 years in the remaining forests in the contiguous states.

Clearcutting in patches of 40 acres or less constitutes the major cutting practice, in terms of harvest volume. In 1974, 900 million board feet were produced from the clearcutting of 19,000 acres primarily located in northwestern Oregon. About 45,000 acres are partially cut annually in southwestern Oregon and the remaining contiguous states. As the old growth stands are replaced with young growth the extent of clearcutting will significantly diminish. During and after this transition a system of cutting that maintains a continuous forest like appearance will be increasingly employed.

The development of the transportation system, one of the major actions associated with timber production, presently involves the construction of about 500 miles of road a year. While current plans call for the completion of the road network in about 30 to 40 years the trend towards more far-reaching logging systems (helicopters, balloons, skylines, etc.) can be expected to shorten this period due to a declining need for an intensive road network.

In addition to the foregoing activities associated with the harvest of trees intensive timber management practices are carried out to varying degrees on lands presently available for timber production. These silvicultural practices are aimed towards the establishment of stands of superior trees and also the treatments necessary to improve productivity through the optimum utilization of growing space. They include tree improvement, site preparation, seeding, planting, brush and hardwood control, precommercial thinning, commercial thinning, mortality salvage and other capital investments carried out for the primary purpose of increasing wood growth and, in turn, production. In actual practice not all of these practices are applied to a given area since many represent alternative methods, the choice of which is dependent primarily upon the conditions that characterize the site or stand. Furthermore, some practices are not carried out at all on given areas because of technical, economic and environmental constraints. Due to these factors and the preponderance of overmature stands only 450,000 acres or 13 percent of the total 3.5 million acres in the current production base will be subjected to intensive management practices during the next decade, based on existing plans.

An integral part of the timber management program is the protection of all forests from insects, disease and fire. The magnitude and nature of this program element in the future is not readily predictable and will vary yearly since it is dependent upon the extent of the areas effected and the causative agents. The predominant control measure is prevention in the form of cutting dead, dying and infected trees in the course of normal harvesting operations along with the development of disease resistant trees. Direct control measures include fire suppression activities and the use of chemicals to combat insect infestations. However, at this time no projects using chemicals to control insect or disease infestations are planned.

The intensity of the Bureau's current timber management program varies between three general geographic areas. At this time the forests of western Oregon are subjected to an intensive level of timber management; timber management practices in interior Alaska forests are essentially limited to fire protection; and the remaining forest are under a moderate program level. Consequently, these areas will be described individually in terms of the current ten year program and expected future trends.

Western Oregon

Approximately 1.9 million acres of the 2.4 million acres of Bureau administered lands, located on the Coast Range and the western approaches to the Cascade Mountains, are classified as available for timber production. These lands represent over 50 percent of the 3.5 million acres currently in the Bureau's total timber production base and are some of the most highly productive and intensively managed lands in the nation. The annual production from these lands is 1.172 billion board feet or 92% of the Bureau's total timber production and nearly 20% of the total wood harvested in western Oregon. The annual production supports 13,500 primary jobs and 20,000 secondary jobs (retail trade, service, etc.) These jobs represent 8 percent of the total employment in the region but ranges as high as 35 percent in some local areas.

Over 90 percent of the current annual production is in the form of old growth Douglas-fir (stands 200 years in age and older). The forests support approximately 50 billion board feet of merchantable timber having an annual net growth of 360 million board feet. The fact that the annual production of 1.172 billion board feet is approximately three times greater than the current annual growth is due to the extensive old growth stands having extremely low or negative growth rates. Current plans call for the harvest of the old growth timber over the next twenty-five year period. As these stands are replaced with a thrifty young growth stands the annual growth rates will increase over time until by the year 2070 the forest will be growing at the rate of 1.275 billion board feet each year and producing crop trees averaging 83 years in age. Consequently, based on the current timber management plan the annual allowable cut will increase over time until it equals the annual growth of 1.275 billion and remain stable thereafter. At this time there is no decrease planned in the production from these lands any time in the future.

The current timber management program, which is an aggregation of individual programs for 13 sustained-yield forests, was adopted in 1971 and is based on the policies and procedures described in Sections B, C, and D, in this chapter. One of the significant elements of this program is the exclusion of 49,000 acres of commercial forest land from the timber production base and the classification of 154,000 acres of modified cutting practices in order to protect and provide for other forest values and uses. These classifications represented a 48 million board feet reduction in timber harvest each year. In turn, the cutting restrictions provide for:

- Protection of 78 existing and 172 future recreation sites.
- Protection of 47 miles of wild and scenic rivers.
- 2,000 miles of streamside protective corridors.
- 380 miles of scenic roadside corridors.
- Protection of 3,000 acres of designated scenic areas.
- Protection of 118,000 acres of livestock range and critical wildlife habitat areas.

In addition, 108,000 acres of forest land are classified as not available for timber production due to critical watershed and fragile site conditions which contributed to a further decrease in annual production. Thus, a total of 311,000 acres or 15 percent of the forest land base is classified for no cutting or special cutting practices in order to protect or enhance environmental values.

The program calls for the following actions which impact the environment to be carried out each year:

- Clearcutting of 19,000 acres of mature timber.
- Partial cutting of 30,000 acres of mature timber.
- Precommercial thinning of 10,000 acres of unmarketable immature timber.

- Commercial thinning of 2,400 acres of marketable immature timber.
- Salvage of dead mature timber on 5,500 acres.
- Reforestation of 23,000 acres, primarily through planting.
- Reforestation of 24,000 acres with genetically improved trees beginning in 1978.
- Prescribed burning of debris on approximately 9,000 acres following logging.
- Brush, weed and hardwood control on 1,900 acres through approved chemical herbicide and mechanical treatments during fiscal year 1975. Thereafter, approximately 5,000 acres per year will be treated.
- Conversion of 370 acres of hardwood stands presently occupying conifer sites.
- Construction of approximately 400 miles of roads.

The western Oregon lands are currently undergoing an intensive inventory aimed at providing more detailed information regarding intensive management opportunities as well as land use and ecological data. As these inventories are completed on the thirteen individual sustained-yield units in western Oregon during 1976-1977, their timber management programs will be updated to reflect any biological, technical, social, economic or other changes that have occurred since the previous programs were developed.

While it is difficult to predict what these changes will be, it may be expected, based on past trends, that the timber production base acreage will be further reduced somewhat because of multiple-use and environmental factors. This may be partially offset by the inclusion of lands previously exempt from timber production due to improved technology. The extent of the acreage to be subjected to existing intensive timber management practices can be expected to undergo no significant change in the revised programs. However, fertilization, a practice which has been undergoing testing in regards to its possible impact on water quality, will undergo further operational tests to the extent of 10,000 acres in fiscal year 1975. If test results continue to be favorable the practice will be incorporated in the revised programs. The use of a unit of measure, such as cubic feet, to reflect increasing utilization of wood material for multi-products may prove timely during this decade. These and other variables along with any policy changes resulting from changing public needs can influence the magnitude of the timber harvest level. Nonetheless, no major changes are foreseen at this time in the intensity of the western Oregon program and its corresponding level of timber production within the decade.

Alaska

The Bureau currently manages an estimated 19.5 million acres of commercial forest land in interior Alaska. These lands support approximately 25 billion board feet of timber, primarily white spruce, with an estimated annual producing capacity of 72 million board feet. (Preliminary results from the current inventory of interior Alaska initiated in 1966 indicate that these data, based on an earlier extensive inventory, may be too high.) Timber harvesting is extremely limited in these forests since they are remote and a means of transporting the material to far-off markets is unavailable. The harvesting to date has been primarily limited to house logs and firewood to meet the domestic needs of scattered native inhabitants and in the past decade timber sales have steadily decreased from 3.8 million board feet in 1964 to zero in 1974.

Uncertainty is the key word in describing the potential development of the timber resource because of unknown silvicultural systems, partially defined ecological relationships, divergent estimated of commercial forest area and inventory volumes, unknown future markets, unplotted transportation and doubtful land tenure. For the immediate decade it is expected that timber production will not exceed, at the very most, 10 million board feet annually.[2] Disposals up to this volume may be needed to fill local domestic use requirements and for oil exploration/pipeline construction purposes, however, no timber sales are currently planned.

If demand does materialize, cutting units will be kept small and carried out only in areas which have been classified as available for timber production. The thrust of the timber management program in interior Alaska is expected to be the continued protection of the resource from fire through prevention and suppression practices and research directed towards white spruce silviculture.* Consequently, the cumulative environmental impacts of the interior Alaska program approximate quite closely those identified for the no timber management program described in Chapter VIII, Alternatives.

Remaining Forests

The intensity of the timber management program for the remaining 1.6 million acres of public forests is at a moderate level, falling somewhat mid-way between the highly intensive program of western Oregon and the protection program of interior Alaska. The distribution of these commercial forest lands which support 8 billion board feet, over eleven Western States are as follows:

	Acres		Acres
Arizona	7,800	Oregon (eastern)	171,000
California	250,000	South Dakota	5,800
Colorado	221,200	Utah	5,400
Idaho	244,200	Washington	52,600
Montana	314,700	Wyoming	238,900
New Mexico	88,900		

---

* A programmatic environmental impact statement is presently being prepared for all aspects of the Bureau's fire management program.

The current timber management program for these lands was developed in the mid-1960's. It is an aggregation of individual programs for 18 sustained yield forests with a total annual cut of 148 million board feet. However, the annual production has decreased in recent years from 145 million board feet in 1968 to 37 million board feet in 1974. The current inventory of these forests, initiated in 1971, represents the primary reason for this reduction because of the diversion of limited funds and manpower to the reinventory effort. The approved fiscal year 1975 budget relaxed this constraint and the offering of approximately 145 million board feet is planned for that year. Target production is as follows:

	Million bd. ft.
California	54
Colorado	20
Idaho	26
Montana	6
Oregon (eastern)	32
Washington	3
Wyoming	4

The major timber management practices that impact the environment are shown on an annual basis under the current 10 year plan as follows:

- Partial cutting of 40,000 acres of mature timber.
- Clearcutting of 800 acres of mature timber.
- Reforestation of 2,400 acres.
- Site improvement through scarification of 300 acres prior to reforestation.
- Precommercial thinning of 600 acres of unmarketable immature timber.
- Brush, weed and hardwood control on 200 acres through approved chemical treatments.
- Commercial thinning of 500 acres of marketable immature timber.
- Construction of approximately 100 miles of road.

As stated previously, the reinventory of these forests is currently in progress with the completion of the last unit scheduled in 1976. As the inventory information becomes available for each unit, revised timber management programs will be developed in conjunction with multiple-use management plans. While it is difficult to anticipate the results of these efforts it is expected that the amount of forest land available for timber production will be significantly reduced due to other forest uses and environmental considerations.

At the same time it is expected that increased opportunities for capital investments to increase timber yields on lands classified for timber production will be identified and the management program intensified accordingly. These investments will primarily relate to increased reforestation and precommercial and commercial thinnings. Because of the foregoing off-setting factors, no significant change in the present annual cut of 148 million board feet is foreseen at this time for these lands within the decade. Consequently, the annual production will continue to support approximately 2,000 primary and secondary jobs.

In a longer time frame, the projected trends in improved utilization, logging system technology, and increasing program intensification as old growth stands are replaced with young growth can be expected to apply to these forests as well as those in western Oregon.

B. Forest Management Objectives and Policies

The timber management program is only one component of the forest management program which is carried out in accordance with the laws, statutes, and regulations pertaining to the lands under the administration of the Bureau of Land Management. The basic guidance set forth in these authorities requires that forest lands be managed under the principles of multiple use, sustained-yield and environmental quality. Forest management is defined so as to include the management of the land along with the wildlife, water, minerals, timber, recreation, forage and other resource values associated with it. The principal laws relating to the management of these resources include the Federal Water Pollution Control Act, Clean Air Act, Fish and Wildlife Coordination Act, Bald Eagle Protection Act, Federal Environmental Pesticide Act, Revested Oregon and California Railroad and Reconveyed Coos Bay Wagon Grant Lands Act and Taylor Grazing Act. Consequently, in the hierarchy of objective and policy levels, these laws and the principles included therein take precedence over specific timber production oriented objectives and policies and, in turn, provide the framework within which the timber management program is developed.

While the Revested Oregon and California Railroad and Reconveyed Coos Bay Wagon Road Grant Lands Act of 1937 applies only to the revested and reconveyed lands under the Bureau's administration in western Oregon, it typifies the intent of corrallary Federal legislation in stating that forest lands, "shall be managed . . . for the purpose of providing a permanent source of timber supply, protecting watersheds, regulating stream-flow . . . and providing recreation facilities." This Act, attached as Appendix C, was considered to be the first law which provided specifically for multiple use and sustained yield management of Federal lands. It was later joined by the now expired Classification and Multiple Use Act of 1964 which extended these principles to the remainder of the Bureau administered forest lands. The environmental considerations required under both of these Acts were made explicit and a procedural process for their evaluation set forth with the passage of the National Environmental Protection Act of 1969.

The three basic principles of multiple use, sustained-yield, and environmental quality are embodied in the following listing of the major objectives and policies that guide the Bureau's forest management program.

- That forest lands provide a balance of resource goods and services as determined by national goals and priorities in order to meet the economic and social needs of the public, both now and in the future.
- That land use conflicts, when they exist, by reconciled to the extent possible through appropriate management practices. If unreconcilable, that the land be classified for a single use or combination of uses in consideration of local, state, or national priorities.
- That lands be managed so as to achieve a high level or regular periodic output of the various resources without impairment of their inherent productivity or quality.
- That lands be protected so as to minimize losses or damage to the forest resources as a result of fire, insects and disease.
- That lands be managed so as to encourage productive and enjoyable harmony between man and his environment, to promote efforts which will prevent or eliminate damage to the environment and stimulate the health and welfare of man.

The achievement of these objectives and policies requires the forest management program to be representative of a coordinated multi-resource plan that is based on technical, social, economic and environmental criteria. As such, its formulation and implementation involves the utilization of expertise relating to the biological, social and economic arts or sciences. Additionally, public input and review are solicited during the planning and subsequent stages in order for the Bureau to be more effective in responding to the national interest.

C. Forest Land Use Planning Procedures

A timber management program for a given forest is the outgrowth of a process known as the Bureau Planning System which is used to develop and maintain land use plans for all Bureau administered lands.* The purposes of the Bureau Planning System are to:

- Permit informed and objective multiple use decisions through the identification and reconciliation of conflicting land and resource uses in advance of on-the-ground action.
- Help insure that land and resource use, development and management plans and program decisions are responsive to Congressional, Departmental, and Bureau objectives.

---

* Refer to BLM Manuals 1601-1608 for further information regarding the system.

Under this system, land use plans are referred to as Management Framework Plans. The Management Framework Plan for a specific forest describes the various resource uses which are permissible in the area pursuant to existing laws and after consideration of the governing guidance, the facts about the resources and uses, the views of the public, and other inputs to the decision making process. In addition, it describes the constraints on the planning for the realization of those uses which are necessary to insure compatibility of uses, protection, and enhancement of the environment, stability of dependent communities, and other objectives of management. The plan is prepared by multidisciplinary team at the field level, working in close coordination with a variety of groups and interests in an organized public participation process. Following the approval of the Management Framework Plan, program activity plans are then prepared for each resource, such as the timber management program, to lay out, in detail, how each activity will achieve the objectives and meet the constraints shown in the Management Framework Plan. Consequently, the Bureau Planning System represents the process in which many of the mitigative measures described in Chapter IV are brought to bear in shaping the timber management program.

The Bureau Planning System has three classes of components for the development of land use plans; guidance, information and decision. Guidance includes basic Bureau responsibilities, land management objectives, principles such as multiple use, sustained yield and environmental quality, planning assumptions, standards, program activity policies and outlooks and land use decision criteria, and guides. Information includes economic, environmental and social data, base map data, physical resource data, present resource use, trends and problems, and the capability and opportunities for future development of each resource. The decision component brings the guidance and information components together to develop the Management Framework Plan which represents a "general" plan designed to establish objectives and coordination for all of the resource program activities in the planning area. To attain this end the decision component consists of three steps. First, a proposal for each resource program activity is made based on its capability developed in the information component, the need and demand for the resource as shown by the economic and social data, public input, and the guidance relative to that activity as shown in the various Bureau guidance and policy statements. Secondly, the different resource activity recommendations are compared, overlaps and conflicts identified, potential "trade-offs" quantified, and the conflicts reconciled to the extent possible using land use criteria, environmental considerations and other guidance. Third, provision is made as a discreet step, for staff and public review and approval by the appropriate official(s).

While the objectives, policies, and procedures followed in the development of the timber management program are described in the next section, they are in actual practice, largely brought to bear during the foregoing land use planning process. Consequently, a general timber management plan is developed at the same time the Management Framework Plan is developed. Following the approval of the plan a more detailed timber management program in terms of scheduling, manpower, funds, etc., is developed for alternative production levels, when applicable, for those lands available for timber production.

Presently, the Bureau Planning System is being followed in updating the timber management and other resource programs for the lands under the Bureau's administration. With the exception of western Oregon, the public forest lands are currently undergoing a reinventory in order to update the resource informational requirements for the formulation of Management Framework Plans and the development of new program activity plans. The timber management program adopted in 1971 for the public forest lands in western Oregon preceded the Bureau Planning System, however, the procedures followed in that effort were consistent with the principles and intent of the Planning System.* These lands are currently being reinventoried with an intensive timber oriented inventory in order to increase and improve the quality of the resource data for application throught the Bureau Planning System. These efforts are representatives of the continuous land management planning cycle necessary in order to be responsive to technological progress, increased information, and changing public needs.

---

* Refer to BLM Report, "An Allowable Cut Plan for Western Oregon", March 1970, for further information.

D. Timber Management Objectives, Policies and Procedures

The acts which relate to the disposal of timber include the O&C Act of 1937 (50 Stat. 874; 43 U.S.C. 1181 et. seq.), Materials Sales Act of 1947 (61 Stat. 681; 43 U.S.C. 1185, as amended) Act of 1898 (30 Stat. 414; 48 U.S.C. 423, Act of 1926 (44 Stat. 960) and the Public Land Administration Act of 1960 (74 Stat. 506; 43 U.S.C. 1362).

The primary objective of the timber management program is to produce a high level of raw material from forest lands classified as available for timber production, subject to the principles of multiple-use, sustained yield and environmental quality. In addition to the laws setting forth these principles, the program is designed to support the Housing and Urban Development Act of 1968. This law specifies a substantial increase in the supply of raw material from all Federal forest lands to help meet housing goals. More recently this same goal was expressed in the President's June 19, 1970, statement, instructing the Secretary of the Interior to: "Improve the level and quality of management of the forest land . . . to permit increased harvest of softwood timber . . . to meet our housing goals."

The amount of timber to be harvested represents one of the major quantifiable elements of the timber program that can be directly correlated to management goals. Consequently, the policies that are followed in planning the level of production warrant mention.

The primary determinants of the level of production, commonly referred to as the allowable cut, can be expressed in over-simplified terms as being the amount of land available for the commercial production of trees and the expected yields from these trees, now and in the future. These determinants are, in turn, a function of such variables as land use, the regulation of wood flow, and the intensity of the timber utilization and management program and the length of the planning horizon. The major policies that address themselves to these variables and are followed in planning the timber management program, in terms of the allowable cut, are briefly as follows:[4]

- The size of the area for which an allowable cut is determined should be such as to permit access to a sustained source of timber for each of its substantial markets or its clusters of communities within which conversion facilities are sufficiently varied to utilize the timber output.
- The allowable cut shall only include forest land judged to be suitable and available for sustained timber production. Forested lands managed for aesthetic, recreational,

watershed and other uses are compatible with limited timber production. However, their yields shall be adjusted to reflect any modified management of cutting practices which reduce timber productivity.

- The allowable cut shall be based on the principles of sustained yield which requires planning for a high level and undiminishing flow of wood over time. While the actual harvest may vary from year to year, the principle shall be considered fulfilled if the average annual output for each ten year period promises to remain constant or increase from one decade to the next.
- The allowable cut level shall include the volume from all planned timber harvesting practices such as final harvest, mortality salvage and commercial thinning. Their individual outputs may vary from decade to decade, however, in total shall meet the sustained yield principle.
- The unit of measure used in the allowable cut shall provide an accurate measure of the end product objective, i.e., sawlogs, pulpwood, etc. Additionally, trends in efficiency in the utilization of trees harvested will be recognized in the allowable cut.
- The influence of present and future intensive management practices, e.g., precommercial and commercial thinnings, shall be reflected immediately in the allowable cut when included in the timber management program. However, before any practice is considered for inclusion it shall first be analyzed for environmental, technical and economic feasibility.
- Forecasts of present trends or future changes will be part of allowable cut planning. The planning horizon should be flexible, with short horizons in some cases and long horizons in others. Normally the second decade shall represent the period upon which

future practices shall be based. While no major developments or innovations beyond this twenty-year period shall be assumed, the practices forecasted to be in effect by this time shall be considered as ongoing programs there after.

- Generally, the allowable cut will be recomputed every ten years for a given planning unit to coincide with the normal ten-year inventory cycle. However, if the situation warrants, it may be recomputed at any time in order to reflect catastrophic losses, policy, procedural and land use changes, or other changes in the assumptions underlying the existing cut.

The implementation of these policies in arriving at an allowable cut is accomplished by use of a computerized forest simulation model developed by the Bureau in 1969 for long-range planning. This model projects the forest lands classified as available for timber production into the future in order to measure the effects of alternative timber management program levels on the allowable cut.* Program levels may be defined as management intensities relative to the inclusion of such practices as genetics, brush and hardwood control, precommercial and commercial thinning and/or others. Consequently, the model permits alternative program levels to be evaluated on the basis of their respective production levels and economic efficiencies and subsequently serves as a basis for programing manpower and funds for the alternative selected. The selection of the alternative is guided by the management Framework Plan, as described in the previous section, for the particular forest along with budgetary and manpower considerations. (Note: This model can also be used in the development of the Management Framework Plan during the forest land use planning phase, as described in the section cited above, in identifying general program potential and in qualifying "trade-offs" in timber production when forest lands are excluded from cutting or subjected to reduced yields in deference to other forest values and uses).

---

* Refer to BLM Manual 5240 and the Policies and Procedures for Planning the Allowable Cut, July 23, 1968, for further information regarding Allowable Cut Planning.

The selected alternative is subsequently translated into a short-range activity plan in terms of an annual program for a five year period. Money and manpower needs in conjunction with planned accomplishments, consistent with the assumptions underlying the selected alternative, are identified for budgetary purposes. In addition to data directly related to timber management practices the budget submission includes support services such as cadastral surveying, easement and right-of-way acquisition and engineering. The development of the timber management activity plan is coordinated with other resource activity plans, e.g., wildlife habitat and watershed, and in concert with one another represent the forest management program for the planning unit.

One of the major inputs in formulating and in later implementing the timber management program is the annual timber sale plan. In addition to manpower and funding needs this document sets forth general information for each proposed timber sale area in terms of its location, approximate volume to be harvested, cutting practices to be followed, method of logging, road construction and access requirements, special contractual provisions and other relevant data. As an integral part of the development of the annual sale plan, an environmental analysis record is prepared for each prospective sale which describes the environmental impacts and mitigative measures to be employed in planning and executing the various sale associated actions. The sale plan is developed in accordance with the general land use and timber management planning policies, as previously described, and the following major guidelines.[5]

- Roads and other facilities will be kept to the minimum, and where needed, will be located, designed and constructed, to the standards necessary for the total land use and resource values involved. Excavation will be limited to the practical essential amount needed to meet the necessary standards. Planning will provide for stabilization of soil exposed and for rehabilitation of other environmental damage during construction.
- Cutting systems will be used which best meet the management goals and related land use prescriptions, and assure prompt regeneration of the forest. Selection, shelterwood, clearcutting or their various modifications are available options. If clearcutting is determined to be the appropriate system, the cutting units should not exceed 40 acres in nomal circumstances and shall be consistent with the guidelines set in the report by the Federal Subcommittee on Public Lands on clearcutting on Federal lands. More than 40 acres may be appropriate for salvage of an area already environmentally damaged by fire, insect or wind, or where larger cutting units will minimize road construction and other actions which would result in

greater adverse environmental impact on the total forest.

- Cutting areas should be so designed that they blend naturally with topography and landscape. The cutting area should minimize the effect on the total forest vista, with due regard for future harvesting impacts of road construction and other relevant factors.
- Slash and cull log disposal will be an integral part of sale planning with the emphasis on techniques that encourage the utilization of residual material. Preference in order of consideration is utilization, chipping, lop and scatter, burying, pile and burn, burn in place. Follow-on reforestation and intensive management requirements must be essential considerations in the selection.
- Assurance of regeneration by natural or artificial means must be an essential element of sale planning.

The timber sale plan is reviewed both internally and by the public prior to approval to insure that proper and full consideration is given to technical, economic, social and environmental criteria. Comparable plans including an environmental analysis record, are also developed and reviewed for the other timber management practices including reforestation, site and stand improvement, etc. Together, these plans constitute the proposed timber management program, which is then subjected to final Congressional review and approval through the appropriation process prior to implementation.

E. Operational Practices

Individual practices are carried out on the ground, consistent with the approved timber management program, for the purpose of increasing the productivity of the timber resource and its availability for public use. They include protection, site preparation, seeding, planting, site and stand improvement, intermediate and final harvests, and the development of transportation systems. Certain of the practices included in this statement are the subject of individual draft environmental impact statements presently being prepared. These include fire management, chemical toxicants, chemical pesticides and container disposal.

Before describing the practices it should be understood that many practices associated with timber production are not being presently applied to all forest lands under the Bureau's administration, nor will they in the future, because of technological, economic, or environmental constraints. For example, the forests of interior Alaska are not presently subjected to almost any operational practice, including harvesting, primarily because of the economic nature of their isolation from existing utilization and market centers. In addition, certain practices such as fertilization, are currently restricted to limited test areas in western Oregon in order to determine their possible impact on the environment before they are considered operational. This matter is only raised to inform the reader that while some of the practices are not included in the current or projected program for certain locales their potential for future application does exist and therefore they are discussed.

The practices that are included in the timber management program are subjected to detailed operational planning and layout. This requires on-the-ground activities conducted by Bureau personnel prior to the action being taken, such as delineating the area to be planted, marking the trees or stands to be harvested, staking the road location, etc., in conjunction with gathering information pertinent to the practice. The outgrowth of these activities is a detailed plan for a specific area and the action to be taken on it. As an integral part of the planning process the environmental analysis report, prepared earlier during the development of the annual plan, is reviewed and updated or modified accordingly. In addition, an environmental analysis is prepared for each timber sale or project and an environmental impact statement written when required.

Since most practices are carried out by private parties, a contract, usually awarded on a bid basis, becomes the instruction for executing the particular action. For example, a timber sale contract is awarded to the highest bidder for a given stand of timber designated for harvest. The stipulations contained in the contract set forth the standards and specifications to be followed by the contractor in carrying out the action in accordance with Departmental and Bureau regulations and policies. These stipulations specify the measures to be followed or taken in accomplishing the action and the manner in which it is to be performed in order to minimize or eliminate its impact on the environment. The stipulations available for inclusion in a contract are set forth in Appendix A along with a sample timber sale contract in Appendix B. The contract is administered, through inspections by Bureau personnel to insure compliance to its intent and the terms contained therein. Consequently, the operational planning, contract preparation and administration phases, together with the land use and program planning phases, represent the hierarchy of levels upon which the mitigative measures to be discussed in Chapter IV are brought to bear in the timber management program. These procedural and administrative levels are common to all timber management practices, however, the following practices will be described solely in terms of their physical or biological characteristics without regard to the mitigative measures actually employed in their planning and implementation. The extent of their application based on the current 10-year plan are also described.

1. Forest Development

Practices included in the development phase of the timber management program are primarily aimed at (1) re-establishing trees on forest land following harvest or natural catastrophies, and (2) insuring satisfactory or optimum growth of these forests.[6] Actions directly associated with timber harvest, such as cutting practices designed to provide regeneration through natural seeding, are discussed in part 3, Harvest, even though they bear upon the questions of re-establishment and growth. The individual practices listed below are in the general order in which they might be carried out, although several may be accomplished simultaneously. Furthermore, not all of these practices are carried out on a given area since many of the practices represent alternative methods; the choice of which is dependent upon the conditions on the area.

a. Tree Improvement

Tree Improvement programs are developed to optimize specific genetic characteristics such as growth rate, or resistance to disease. Major efforts to date involve (1) development of fast growing Douglas-fir and ponderosa pine, in the Horning Tree Seed Orchard, Molalla, Oregon, and (2) development of sugar pine trees resistant to white pine blister rust in the Sprague Tree Seed Orchard, Merlin, Oregon. The program provides genetically improved tree seed or seedlings for use in reforestation activities.

Tree improvement programs require development of (1) centrally located "seed orchards" where genetically improved seed can be produced, and (2) "progeny test areas" where improved seedlings can be grown and measured. Development of these areas often requires harvest of timber on selected sites followed by cultivation to prepare the site for planting. High values associated with seed orchards and progeny test areas often require control of insects and disease with insecticides and fungicides. Such pesticides are applied using hand compression sprayers, gas bombs, injection or tractor drawn ground sprayers.

b. Scarification

Heavy machinery such as crawler tractors, equipped with toothed brush blades are used to uproot woody vegetation and to pile it for burning, decomposition or disposal by burying. This measure is taken to prepare the site for seeding or planting by exposing mineral soil, conserving soil moisture, providing sunlight, destroying habitat of seed or seedling eating animals and/or guarding against fire. Approximately 1000 acres, 700 of which are located in western Oregon, are scheduled for scarification annually.

c. Mechanical Brush Cutting

Heavy, tractor-drawn "brush-cutters" are used to chop and crush woody vegetation and debris in place in order to prepare the site for seeding or planting. While this practice has been recently applied to some 500 acres in Colorado its use will be infrequent throughout the Western States.

d. Mechanical Trenching - Furrowing

Tractor-drawn implements are used to construct furrows, trenches or cleared spots in herbaceous vegetation prior to seeding or planting. No mechanical trenching and furrowing is planned at this time.

e. Area Burning

Burning may be for the purpose of preparing for reforestation, reducing potential fire hazards, and/or protecting existing stands by destroying material infected with insects or disease. It generally involves movement of one or more relatively continuous lines of fire over several contiguous acres for the purpose of destroying woody vegetation and debris, such as logging slash. In conjunction with spot burning, approximately 9,000 acres will be burned each year, mostly in western Oregon. This treatment may also require pre-treatment with a chemical such as Denitro to dry wood vegetation prior to burning. In fiscal year 1975, 300 acres in western Oregon are planned for this treatment.

f. Spot Burning

Piles, or concentrations, of woody vegetation and debris (such as logging slash or slashing from pre-commercial thinning) are destroyed by burning for the same purposes listed above.

g. Burying

Logging slash or debris resulting from scarification treatments are buried in pits constructed by heavy equipment such as crawler tractors for the same purposes as broadcast burning. This practice will continue to be limited to the burying of right-of-way logging debris in the course of road construction.

h. Chipping

Logging or thinning slash is handled by chipping it and disposing of it on site or other suitable disposal areas. In some instances the chips are transported to a utilization facility for processing. While the potential for this practice appears promising, chipping will be somewhat limited due to economic considerations.

i. Hand Clearing and Cleaning

Hand tools (such as hoes, axes, and power saws) are used to clear individual planting or seeding spots of vegetation and debris, or to remove competing vegetation from existing trees. This practice will sometimes be carried out in conjunction with the planting of some 25,000 acres annually.

j. Seeding

In field seeding operations, as opposed to seeding in nurseries, seed may be scattered by helicopter or by crews walking over the area and depositing seed in selected spots. Seed used in seeding operations is normally treated with chemicals to provide protection from seed eating rodents and birds. Protection may be obtained when seed eating rodents "learn" not to eat treated seed after having ingested sublethal amounts. Protection from birds may obtained by changing seed color. Due to the banning of the use of the chemical seed protectant, Endrin, seeding will be limited to approximately 350 acres a year.

k. Planting

Tree planting is done by hand using tools such as hoes, maddocks, dibbles, power augers, or tractor-drawn machine where terrain is favorable. Trees used in planting are classified as "bare-root" or "containerized." Bare-root seedlings are removed from the ground in forest nurseries, packaged and transported to the forest to be planted. Containerized seedlings, however, are grown in containers and are transported to the forest in the containers. Depending upon the specific type of container, the planter may either remove the seedling from the container prior to planting or plant the container itself.

Current plans call for the planting of 23,000 acres annually in western Oregon and 2,400 acres annually in the remaining contiguous Western States. The tree seedlings used are commonly treated in the nursery with a chemical to repel animals that may otherwise feed upon them. Repellency may be secured by rendering the treated tree unpalatable; growth that occurs after planting is not protected.

l. Chemical Weed Control

Chemicals are applied to control herbaceous vegetation or woody vegetation prior to or subsequent to seeding or planting. Applications are made by aerial or hand methods. Current plans call for the spraying, mostly through aerial means of about 5,000 acres in fiscal year 1975 in western Oregon using Tordon 101, Atrazine, Dalapon, Tordon 10K, Banvel 520, Banvel 72C or 2, 4-D. At this time, 25 percent of the project acreage has been approved. The acreage to be treated in subsequent years is expected to decrease. Some 100 acres in the remaining contiguous states will be subjected to chemical need control each year.

m. Baiting

Poisoned bait may be distributed, aerially or by hand, to kill seed or seedling eating animals such as mice, woodrats, rabbits, snowshoe hare or porcupines. The only baiting projects contemplated in the near future is the use of strychnine on approximately 1,000 acres in Colorado to control pocket gophers and the experimental treatment of 200 acres in western Oregon with Rozal to control rodents.

n. Fencing and Screening

Involves construction of fences or screens to protect seed or seedlings from animal damage. Fencing generally involves protection of entire areas from domestic livestock or big game while screens may be used to protect individual trees or cut spots from nearly all kinds of animals. Due to the costs involved this practice has been essentially limited to the two tree seed orchards and progeny outplantings in western Oregon and several fire denuded areas in California to protect some 200 acres of plantations established in critical watershed areas.

o. Mulching

Usually involves placement of paper or plastic mulch around individual trees to control competing herbaceous vegetation. This practice will have extremely limited application due to physical limitations and high costs.

p. Snag Felling

Live or dead trees sometimes have to be felled if they are tall enough to interfere with low flying aircraft conducting herbicide applications. Dead trees (snags) are felled to prevent their throwing sparks in the event of a fire. This practice will be restricted almost solely to fire suppression activities.

q. Fertilization

This practice involves aerial distribution, usually by helicopter, of a fertilizer, primarily nitrogen in the form of urea pills. Application rate is generally between 150 and 300 lbs. of effective nitrogen per acre. Although effects of a single application of fertilizer on annual growth can usually be recorded over a 10-year period, there may be a marked reduction after approximately 5 years. Frequency of application thus ranges between 5 and 10 years depending on local conditions. Fertilization involves the movement of tons of fertilizer from supplier's base (by rail boxcar or truck and trailer) to an intermediate point, and from the intermediate point (usually by dump truck) to the base of operation (airstrip or heliport). The operation may thus require construction or improvement of the forest road system to allow movement of large vehicles near to the fertilization site. Heliports or airstrips may also have to be built.

At this time, fertilization is not an operational practice but is being tested in western Oregon for both economic and environmental feasibility. Preliminary results are favorable on both counts and 10,000 acres are scheduled for further testing in fiscal year 1975.

r. Precommercial Thinning

Surplus trees in established stands of young, premerchantable timber are cut or poisoned so as to release selected trees from competition for light, moisture or nutrients, thereby concentrating growth potential of the stand on fewer trees of better quality. The primary objectives are to produce merchantable wood volume and financial returns earlier than the unthinned forest, and to produce more total wood for harvest.[7] Thinning of merchantable size stands, where trees removed are sold, is discussed in the section Intermediate Cuttings.

Precommercial thinning may involve the use of power saws, chemicals (silvicides such as cacodylic acid or MSMA), axes or other tools to cut or poison individual surplus trees. Surplus trees are usually chosen from those trees whose crowns make up the general level of the stand canopy. Trees taller than the general level of the stand may be cut or poisoned only if soil moisture is a critical factor for increased growth of remaining trees. Severed trees may be left standing or forced to the ground.

The above techniques may also be used to cut or poison rows, or strips, of trees on the basis of "predetermined spacing or pattern with little or no regard for their position in the crown canopy."[8] This method is usually limited to very young, uniform stands, and may also involve use of heavy machinery, such as crawler tractors and tractor-drawn brush cutters, to crush strips of trees several feet wide leaving narrower strips of standing trees in between. Precommercial thinning may also be done for the primary purpose of removing diseased trees in order to control an infection such as dwarf mistletoe.

Approximately 10,600 acres are scheduled for precommercial thinning each year; 10,000 of which will be in western Oregon.

s. Pruning

Limbs of trees are cut from selected trees for the purpose of improving the quality of wood produced (i.e., knot free) or to control disease (such as dwarf mistletoe). Due primarily to economic factors, no pruning is planned for the future.

t. Stand Conversion

Stand conversion involves the return of coniferous sites encroached upon by hardwoods, following fire or timber harvest, back to coniferous production. This action may include specific practices such as scarification, mechanical brush cutting, chemical spraying or harvest cutting and therefore impacts and mitigation are discussed under these specific practices. Currently, this practice is carried out only in western Oregon on about 370 acres a year by harvesting mature stands of Red Alder and then reforesting with Douglas-fir.

u. Brush and Hardwood Control

This action is taken to reduce or eliminate competition from undesirable species in young established stands of desirable tree species. The principal agents employed are chemicals and therefore the impacts and mitigative measures are discussed under chemical weed control. Current plans call for the spraying, mostly through aerial means, of about 14,000 acres in fiscal year 1975 in western Oregon using Silvex, 2,4-D, Atrazine, or Dalapon. At this time, 25 percent of the project acreage has been approved. The acreage to be treated in subsequent years is expected to decrease. About 100 acres in the remaining contiguous states will be treated each year.

2. Protection

The primary objective of the protection program is to eliminate or minimize losses to the timber resource and other forest resource values resulting from fire, insects and disease. Since the nature of these destructive agents and the practices employed in combating them vary, each will be discussed separately in the parts that follow.

a. Fire Control

Two basic approaches taken on the ground to protect the forest from fires or control their spread involve hazard reduction and suppression. Hazard reduction includes such preventive or pre-suppression practices as slash disposal through chipping or burning, salvage of dead material, fire line construction around cutting areas, road building, firebreaks, fuelbreaks, and snag felling. Because many of these practices have multi-objectives and are carried out in the course of the actions identified in this statement as Development, Harvest and Transportation they will be discussed under one of these actions and not under Protection. Consequently, this section and the Protection Section in subsequent chapters will be limited to practices employed in the suppression or control of going fires.

The objective of fire suppression practices is to break the three principles of combustion, as illustrated by the fire triangle (fuel, oxygen and temperature), at the most vulnerable place by the means available. The application of these practices, often in combination with one another, can therefore be classified on the basis of the three sides of the triangle, as follows:

- Fuel. Reduction in fuel by making a break in fuel continuity, accomplished by physical removal (construction of a fire line), making fuels less available (felling snags) or by making them noninflammable through application of dirt, water, or chemicals.
- Oxygen. Burial of fuels in dirt, smothering with water, fog or chemical substances.
- Temperature. Reduction of temperature through application of dirt, water, or chemicals and partial removal or separation of fuels.

The application of water and chemical retardants in combatting forest fires is accomplished by means of helicopters, fixed-wing aircraft and ground tankers. Fire lines are constructed by hand tools and also by the use of heavy equipment such as bulldozers.

Based on the period 1969-1973, an average of 275,000 acres can be expected to be burned annually, 260,000 acres of which will be in interior Alaska.

b. Insect Control

The objectives of forest-insect control practices are to prevent or suppress epidemic outbreaks of injurious insects and to prevent their spread. With defoliator-type insects, the object is to hold down the injury to as low a point as possible until natural factors suppress the epidemic. In bark beetle control the objective is to prevent or suppress the development of a large beetle population, at the same time giving every encouragement to the natural control agencies, so that the natural balance may be restored.[9]

Control practices can be classified as silvicultural, biological, chemical and physical; the choice of which is primarily dependent upon the species of insect to be controlled, the degree of infestation, and the conditions that characterize the infested area.

(1) Silvicultural Control. This method employs the use of silvicultural practices directed towards preventing the occurrence of insect outbreaks as opposed to actions taken following insect infestations. It consists of maintaining the forest in a healthy condition and regulating its growth so that food conditions are unfavorable for injurious insects. The quantity and quality of insect food are controlled by regulating the composition, density, vigor and age of the stands.[10] Practices include the salvage or burning of windfalls, slash, and other potential insect-breeding places and by cutting operations to remove the trees or stands most susceptible to insect attack. Under certain conditions cutting and regeneration practices are employed in a manner so as to favor the creation of timber stands of mixed species since they are sometimes less susceptible to insect damage than the pure stands. The objectives and practices associated with silvicultural control are by their very nature an integral and normal part of the timber management program and it represents the predominant control measure to be employed on Bureau administered forests.

(4) Direct Physical Control. Mechanical and physical insect control methods usually aimed at beetle-type insects include the use of the following methods:

- Burning -- involves the burning of infected unmarketable material in either tree, log, branch (following pruning) or bark (following peeling) form after the material is piled or decked. It may also involve the burning of standing trees.
- Solar-Radiation -- involves turning thin-barked trees or logs so as to fully expose each beetle infested side to full sunlight for several days.
- Logging -- involves the removal of marketable material to utilization centers and burning the residual infested material. With the exception of widespread infestations this method is usually carried out in the course of the "normal" timber management program.
- Trapping -- involves the use of light, insect attractants, girdled and/or felled trees to attract insects. Host material is then usually destroyed by burning.

c. Disease Control

The objective of forest disease control practices is to eliminate or minimize the occurrence or spread of heart rot, root rot, foliage, stem rust and other tree diseases. Diseases may be caused by the nonliving environment, such as unfavorable soil or atmospheric conditions, or by viruses whose nature is not well understood. The majority of diseases, however, are caused by the activities of living hold down the injury to as low a point as possible until natural factors suppress the epidemic. In bark beetle control the objective is to prevent or suppress the development of a large beetle population, at the same time giving every encouragement to the natural control agencies, so that the natural balance may be restored.[9]

Duplicate

Control practices can be classified as silvicultural, biological, chemical and physical; the choice of which is primarily dependent upon the species of insect to be controlled, the degree of infestation, and the conditions that characterize the infested area.

(1) Silvicultural Control. This method employs the use of silvicultural practices directed towards preventing the occurence of insect outbreaks as opposed to actions taken following insect infestations. It consists of maintaining the forest in a healthy condition and regulating its growth so that food conditions are unfavorable for injurious insects. The quantity and quality of insect food are controlled by regulating the composition, density, vigor and age of the stands.[10] Practices include the salvage or burning of windfalls, slash, and other potential insect-breeding places and by cutting operations to remove the trees or stands most susceptible to insect attack. Under certain conditions cutting and regeneration practices are employed in a manner so as to favor the creation of timber stands of mixed species since they are sometimes less susceptible to insect damage than the pure stands. The objectives and practices associated with silvicultural control are by their very nature an integral and normal part of the timber management program and it represents the predominant control measure to be employed on Bureau administered forests.

(4) Direct Physical Control. Mechanical and physical insect control methods usually aimed at beetle-type insects include the use of the following methods:

- Burning -- involves the burning of infected unmarketable material in either tree, log, branch (following pruning) or bark (following peeling) form after the material is piled or decked. It may also involve the burning of standing trees.
- Solar-Radiation -- involves turning thin-barked trees or logs so as to fully expose each beetle infested side to full sunlight for several days.
- Logging -- involves the removal of marketable material to utilization centers and burning the residual infested material. With the exception of widespread infestations this method is usually carried out in the course of the "normal" timber management program.
- Trapping -- involves the use of light, insect attractants, girdled and/or felled trees to attract insects. Host material is then usually destroyed by burning.

c. Disease Control

The objective of forest disease control practices is to eliminate or minimize the occurrence or spread of heart rot, root rot, foliage, stem rust and other tree diseases. Diseases may be caused by the nonliving environment, such as unfavorable soil or atmospheric conditions, or by viruses whose nature is not well understood. The majority of diseases, however, are caused by the activities of living organisms, i.e., slime, molds, bacteria, fungi, algae, seed plants and animals, including insects.[12]

Disease control measures currently carried out in the forest are essentially limited to silvicultural or physical practices. While a chemical has been developed for treating stumps to prevent the spread of Fomes annousus (root and butt rot) the small amount of damage caused by this disease does not warrant its application. Chemicals are used, however, in nurseries and seed orchards for disease control and are discussed under the Forest Development phase of the timber management program. Biological control, like chemical control, has strong appeal to the imagination but current technology and/or experience offers little hope for application in the forest in the foreseeable future. Consequently, they are not pursued in this statement.

(1) Silvicultural Control. This method employs the use of silvicultural practices aimed at the prevention or minimization of future disease outbreaks as opposed to actions taken following infestations and include:

- Development of disease resistant trees such as rust resistant white pine and sugar pine.
- Development of mixed-species stands where feasible, particularly when diseases are host specific.
- Development of pure stands of naturally disease-resistant tree species where feasible.
- Avoiding damage to residual trees during logging operations.

obtaining natural reproduction by several means [13] and by nomenclature descriptive of the action taken. [14] A practical classification (for the purpose of this subsection) lists cutting practices in two major categories, intermediate cuttings and final harvest cuttings, as follows:

(1) Intermediate Cuttings. These are practices applied prior to the major or final harvest of a stand [15] with the qualification that trees designed for cutting have commercial value.

(a) Commercial Thinnings. Various type and intensities of cutting are applied to immature stands for the purpose of redistributing growth on the uncut trees, to recover and use material that otherwise would be lost, and thus to obtain greater total yield of merchantable material. [16, 17] Dependent upon the age of the stand and other factors, commercial thinnings are conducted at prescribed intervals over the life of the stand. Current plans call for the thinning of 2,400 acres annually in western Oregon and 500 acres annually in the remaining forests at approximately 10 year intervals.

(b) Sanitation - Salvage Cuttings. These are made to remove individual trees killed or injured by fire, insects, fungi, etc., and those trees likely to die prior to the final harvest in order to prevent the spread of insects or disease, and to utilize merchantable material before it becomes worthless. [18] Trees cut may be immature or mature but tree condition, not age, is the criterion for removal. This practice is limited to western Oregon to the extent of 5,500 acres a year.

organisms, i.e., slime, molds, bacteria, fungi, algae, seed plants and animals, including insects.[12]

Disease control measures currently carried out in the forest are essentially limited to silvicultural or physical practices. While a chemical has been developed for treating stumps to prevent the spread of Fomes annousus (root and butt rot) the small amount of damage caused by this disease does not warrant its application. Chemicals are used, however, in nurseries and seed orchards for disease control and are discussed under the Forest Development phase of the timber management program. Biological control, like chemical control, has strong appeal to the imagination but current technology and/or experience offers little hope for application in the forest in the foreseeable future. Consequently, they are not pursued in this statement.

Duplicate

(1) Silvicultural Control. This method employs the use of silvicultural practices aimed at the prevention or minimization of future disease outbreaks as opposed to actions taken following infestations and include:

- Development of disease resistant trees such as rust resistant white pine and sugar pine.
- Development of mixed-species stands where feasible, particularly when diseases are host specific.
- Development of pure stands of naturally disease-resistant tree species where feasible.
- Avoiding damage to residual trees during logging operations.

obtaining natural reproduction by several means [13] and by nomenclature descriptive of the action taken. [14] A practical classification (for the purpose of this subsection) lists cutting practices in two major categories, intermediate cuttings and final harvest cuttings, as follows:

(1) Intermediate Cuttings. These are practices applied prior to the major or final harvest of a stand [15] with the qualification that trees designed for cutting have commercial value.

(a) Commercial Thinnings. Various type and intensities of cutting are applied to immature stands for the purpose of redistributing growth on the uncut trees, to recover and use material that otherwise would be lost, and thus to obtain greater total yield of merchantable material. [16, 17] Dependent upon the age of the stand and other factors, commercial thinnings are conducted at prescribed intervals over the life of the stand. Current plans call for the thinning of 2,400 acres annually in western Oregon and 500 acres annually in the remaining forests at approximately 10 year intervals.

(b) Sanitation - Salvage Cuttings. These are made to remove individual trees killed or injured by fire, insects, fungi, etc., and those trees likely to die prior to the final harvest in order to prevent the spread of insects or disease, and to utilize merchantable material before it becomes worthless. [18] Trees cut may be immature or mature but tree condition, not age, is the criterion for removal. This practice is limited to western Oregon to the extent of 5,500 acres a year.

(c) Shelterwood Cuttings. Removal of mature timber from a stand in a series of cuttings which extend over a period of years. In theory the series is divided into three parts,[19] two of which are herein classified as intermediate cuttings and the third as the shelterwood removal which is described under the final harvest cuttings:

- Preparatory Cutting, which prepares the stand for regeneration by removal of dying and defective trees and trees of undesirable species, prepares the seed-bed and encourages seed production.[19] This initial entry into the stand is planned for 30,000 acres a year in western Oregon beginning in fiscal year 1975. Approximately 40,000 acres in the remaining forests in the contiguous Western States will receive a preparatory cut.
- Seed Cutting, which further opens the stand prior to seeding thus making available the light and heat that the expected seedlings will require.[21] This cut is carried out about 10 to 15 years after the preparatory cut.

(2) Final Harvest Cuttings. In contrast to intermediate cuttings, which include immature trees, final harvest cuttings usually remove only trees which have reached maturity.[20]

(a) Clearcutting. Removal of the entire stand in one cut.[21] This practice is commonly applied to even-aged stands, in which most of the individual trees achieve maturity simultaneously. Species which constitute such stands, e.g., Douglas-fir, are more or less intolerant (light demanding), and are sometimes most effectively regenerated by clearcutting. However, need for salvage may require that uneven-aged stands be clearcut. Disease infestion in timber stands often requires the chain saw is the common tool although mechanized blades mounted on mobile equipment are comming into more use, particularly in dealing with relatively small trees on gentle terrain.

The many logging systems available can be grouped under ground or aerial systems and they will be discussed on that basis.

(1) Ground Systems. These systems can move logs only by dragging (skidding) them along the ground. These are often called "conventional" systems because they were the original logging system and continue to be more widely used than aerial logging systems. Ground systems are currently employed on about 90 percent of the lands subjected to timber harvest and promise to remain the predominant practice in the near future. Following are brief descriptions of some ground systems used in logging operations.

(a) Horse Skidding. Horses are still used advantageously in some situations. On suitable terrain they are well adapted to skidding small logs such as those produced in commercial thinnings. Horses can be used on narrow skid trails with minimum damage to the residual stand. They are best suited to skidding small logs downslope on gradients under 40 percent for maximum distances not exceeding 600 feet. Horse skidding will be carried out in the Black Hills' forests of South Dakota and Montana to the extent of less than 100 acres a year.

(c) Shelterwood Cuttings. Removal of mature timber from a stand in a series of cuttings which extend over a period of years. In theory the series is divided into three parts,[19] two of which are herein classified as intermediate cuttings and the third as the shelterwood removal which is described under the final harvest cuttings:

Duplicate

- Preparatory Cutting, which prepares the stand for regeneration by removal of dying and defective trees and trees of undesirable species, prepares the seed-bed and encourages seed production.[19] This initial entry into the stand is planned for 30,000 acres a year in western Oregon beginning in fiscal year 1975. Approximately 40,000 acres in the remaining forests in the contiguous Western States will receive a preparatory cut.
- Seed Cutting, which further opens the stand prior to seeding thus making available the light and heat that the expected seedlings will require.[21] This cut is carried out about 10 to 15 years after the preparatory cut.

(2) Final Harvest Cuttings. In contrast to intermediate cuttings, which include immature trees, final harvest cuttings usually remove only trees which have reached maturity.[20]

(a) Clearcutting. Removal of the entire stand in one cut.[21] This practice is commonly applied to even-aged stands, in which most of the individual trees achieve maturity simultaneously. Species which constitute such stands, e.g., Douglas-fir, are more or less intolerant (light demanding), and are sometimes most effectively regenerated by clearcutting. However, need for salvage may require that uneven-aged stands be clearcut. Disease infestion in timber stands often requires the chain saw is the common tool although mechanized blades mounted on mobile equipment are comming into more use, particularly in dealing with relatively small trees on gentle terrain.

The many logging systems available can be grouped under ground or aerial systems and they will be discussed on that basis.

(1) Ground Systems. These systems can move logs only by dragging (skidding) them along the ground. These are often called "conventional" systems because they were the original logging system and continue to be more widely used than aerial logging systems. Ground systems are currently employed on about 90 percent of the lands subjected to timber harvest and promise to remain the predominant practice in the near future. Following are brief descriptions of some ground systems used in logging operations.

(a) Horse Skidding. Horses are still used advantageously in some situations. On suitable terrain they are well adapted to skidding small logs such as those produced in commercial thinnings. Horses can be used on narrow skid trails with minimum damage to the residual stand. They are best suited to skidding small logs downslope on gradients under 40 percent for maximum distances not exceeding 600 feet. Horse skidding will be carried out in the Black Hills' forests of South Dakota and Montana to the extent of less than 100 acres a year.

(b) Tractor Skidding. Logging tractors are of two general types, crawler and wheel. The former has a tank-like metal tread while the latter are invariably mounted on rubber and are known as rubber-tired skidders. Both types are sometimes used with a mounted arch or to draw track-mounted arches or rubber-tired sulkies, devices which suspend one end of the log or logs.

Both types of tractor are used most effectively for downhill skidding on slopes under 35 percent, and for maximum distances less than 1500 feet. Uphill skidding for short distances is feasible on gentle slopes, particularly for the larger crawler tractors. Often tractors complement other systems. A combination sometimes used on sidehill settings is downhill tractor skidding of the upper part and uphill high-lead yarding of the lower part to the same roadside landing. The present tractor skidding of almost two thirds of the acreage subjected to harvesting is expected to continue into the near future. It represents the predominant method employed in southwestern Oregon and the remaining forests in the contiguous states.

(c) High-lead Yarding. Despite the increasing application of newer, alternative equipment to logging situations once operable only by high-lead, it remains one of the most important of the moving-cable systems. There are sound reasons for its popularity since many forested areas are too steep, broken or rocky for tractors. On clayey soils tractor operations are frequently impossible during the long rainy season.

(e) Other Ground Systems. Jammers and selfloading trucks are sometimes used for yarding, principally in small logging operations.

- The jammer (usually a homemade machine) employs an erect boom and an engine-powered drum, on which is wound a wire-rope cable used for both yarding and loading. While basically a machine for loading trucks, the jammer amy be used for yarding logs for relatively short distances (usually not exceeding 300 feet). On slopes too steep for tractor operations, the jammer's limited yarding capability can be useful with a system of roads on contours spaced at slope distances of 600 feet or less. Jammer logging is relatively limited and will be localized to some areas in Montana and Idaho.
- The self-loading truck is commonly equipped with a short horizontal boom with fairlead, and cable wound on a drum powered by take-off from the truck engine. Under favorable conditions, such trucks can yard logs from locations within 100 feet of roadside, however, their use is extremely limited on Bureau administered forests. Both jammers and self-loading trucks tend to perform poorly as yarding machines because of low line speeds. Consequently, they are rarely used as such in operations requiring high yarding production.

(2) Aerial Systems. These are capable of moving logs suspended above the ground from stump to landing. Suspension may be complete or partial, i.e., logs can be suspended free of the ground (known as "flying" the logs) or one end of the turn may drag.[27] Less than 10 percent of the acreage subjected to harvest is logged using aerial systems, however, the trend in their increasing use is expected to continue.

The three major types of aerial systems currently operational are skylines, balloons and helicopters; these are discussed separately.

(b) Tractor Skidding. Logging tractors are of two general types, crawler and wheel. The former has a tank-like metal tread while the latter are invariably mounted on rubber and are known as rubber-tired skidders. Both types are sometimes used with a mounted arch or to draw track-mounted arches or rubber-tired sulkies, devices which suspend one end of the log or logs.

Duplicate

Both types of tractor are used most effectively for downhill skidding on slopes under 35 percent, and for maximum distances less than 1500 feet. Uphill skidding for short distances is feasible on gentle slopes, particularly for the larger crawler tractors. Often tractors complement other systems. A combination sometimes used on sidehill settings is downhill tractor skidding of the upper part and uphill high-lead yarding of the lower part to the same roadside landing. The present tractor skidding of almost two thirds of the acreage subjected to harvesting is expected to continue into the near future. It represents the predominant method employed in southwestern Oregon and the remaining forests in the contiguous states.

(c) High-lead Yarding. Despite the increasing application of newer, alternative equipment to logging situations once operable only by high-lead, it remains one of the most important of the moving-cable systems. There are sound reasons for its popularity since many forested areas are too steep, broken or rocky for tractors. On clayey soils tractor operations are frequently impossible during the long rainy season.

(e) Other Ground Systems. Jammers and selfloading trucks are sometimes used for yarding, principally in small logging operations.

- The jammer (usually a homemade machine) employs an erect boom and an engine-powered drum, on which is wound a wire-rope cable used for both yarding and loading. While basically a machine for loading trucks, the jammer amy be used for yarding logs for relatively short distances (usually not exceeding 300 feet). On slopes too steep for tractor operations, the jammer's limited yarding capability can be useful with a system of roads on contours spaced at slope distances of 600 feet or less. Jammer logging is relatively limited and will be localized to some areas in Montana and Idaho.
- The self-loading truck is commonly equipped with a short horizontal boom with fairlead, and cable wound on a drum powered by take-off from the truck engine. Under favorable conditions, such trucks can yard logs from locations within 100 feet of roadside, however, their use is extremely limited on Bureau administered forests. Both jammers and self-loading trucks tend to perform poorly as yarding machines because of low line speeds. Consequently, they are rarely used as such in operations requiring high yarding production.

(2) Aerial Systems. These are capable of moving logs suspended above the ground from stump to landing. Suspension may be complete or partial, i.e., logs can be suspended free of the ground (known as "flying" the logs) or one end of the turn may drag.[27] Less than 10 percent of the acreage subjected to harvest is logged using aerial systems, however, the trend in their increasing use is expected to continue.

The three major types of aerial systems currently operational are skylines, balloons and helicopters; these are discussed separately.

(a) Skyline Yarding. Skylines are moving-cable systems which yard or swing logs suspended between a tail-spar and a head spar. The basic principle of movement is via suspension from wire-rope cables. Modern skyline systems are mobile and have lateral yarding capability. The newer systems can be used for both uphill and downhill yarding. Some are readily convertible to conventional high-lead operation, a feature which increases their utility. Modern skyline systems are of three general types: standing or fixed skylines, slacklines, and running skylines.

- Standing (fixed) Skylines. The operating range of the larger fixed skyline equipment is very great; maximum yarding distance of 5000 feet are possible. This potential, properly utilized, can greatly reduce the road density which would be necessary for logging a given area by conventional means. The larger standing skyline equipment is best adapted to logging larger clearcut settings of heavy timber volumes per acre, in rough topography where the expense of developing intensive road networks would be prohibitive.

  Smaller fixed skyline equipment with yarding capability of 1500 to 2000 feet is available. These machines and rigging are less costly and more flexible than the large skyline-cranes. Properly used, they are adapted to some partial cuttings as well as clearcuttings. While they do not offer the road construction cost saving potential of the larger skylines, they do have an advantage in this respect over the high-lead and tractor systems.

residual stand are not too tall. The removal of overstory timber to release young trees may present good opportunities for helicopter logging.

c. Transportation Systems

The primary purpose of transportation is the context of timber management is to provide a medium for moving logs from the landing or loading site located in the cutting area to a market destination which may be a few miles to a 100 miles distant.[34] The major mediums currently in use are land transportation and water transportation. The former consists of hauling the logs over a road and/or railroad system while the latter involves the utilization of water to transport the logs. Since rail transportation is not used in moving logs on Bureau timber sale areas, and does not appear to hold promise in the future, it will not be discussed.

Water transportation includes the floating, rafting, or barging of logs on such natural waterways as rivers and lakes. Currently this method of transportation is not used in moving logs from Bureau administered lands, with the exception of some isolated instances in interior Alaska. If the timber resource of interior Alaska is subjected to any significant commercial development in the future, the rivers may become the major means of log transport. However, because of the many uncertainties involved water transportation will not be discussed further in this statement. Related to this matter is the use of water to store logs somewhere enroute to a manufacturing facility. At the present time the Bureau is involved with only one log storage dump, located on the Smith River in western Oregon. Since

(a) Skyline Yarding. Skylines are moving-cable systems which yard or swing logs suspended between a tail-spar and a head spar. The basic principle of movement is via suspension from wire-rope cables. Modern skyline systems are mobile and have lateral yarding capability. The newer systems can be used for both uphill and downhill yarding. Some are readily convertible to conventional high-lead operation, a feature which increases their utility. Modern skyline systems are of three general types: standing or fixed skylines, slacklines, and running skylines.

- Standing (fixed) Skylines. The operating range of the larger fixed skyline equipment is very great; maximum yarding distance of 5000 feet are possible. This potential, properly utilized, can greatly reduce the road density which would be necessary for logging a given area by conventional means. The larger standing skyline equipment is best adapted to logging larger clearcut settings of heavy timber volumes per acre, in rough topography where the expense of developing intensive road networks would be prohibitive.

  Smaller fixed skyline equipment with yarding capability of 1500 to 2000 feet is available. These machines and rigging are less costly and more flexible than the large skyline-cranes. Properly used, they are adapted to some partial cuttings as well as clearcuttings. While they do not offer the road construction cost saving potential of the larger skylines, they do have an advantage in this respect over the high-lead and tractor systems.

residual stand are not too tall. The removal of overstory timber to release young trees may present good opportunities for helicopter logging.

c. Transportation Systems

The primary purpose of transportation is the context of timber management is to provide a medium for moving logs from the landing or loading site located in the cutting area to a market destination which may be a few miles to a 100 miles distant.[34] The major mediums currently in use are land transportation and water transportation. The former consists of hauling the logs over a road and/or railroad system while the latter involves the utilization of water to transport the logs. Since rail transportation is not used in moving logs on Bureau timber sale areas, and does not appear to hold promise in the future, it will not be discussed.

Water transportation includes the floating, rafting, or barging of logs on such natural waterways as rivers and lakes. Currently this method of transportation is not used in moving logs from Bureau administered lands, with the exception of some isolated instances in interior Alaska. If the timber resource of interior Alaska is subjected to any significant commercial development in the future, the rivers may become the major means of log transport. However, because of the many uncertainties involved water transportation will not be discussed further in this statement. Related to this matter is the use of water to store logs somewhere enroute to a manufacturing facility. At the present time the Bureau is involved with only one log storage dump, located on the Smith River in western Oregon. Since an environmental impact analysis has been made of this operation entitled, "Operations of the Smith River Log Dump as Related to Water Quality and Aquatic Resources," October 1972, it will not be included in this statement.

The dominant transportation medium currently in use is the hauling of logs by trucks over roads constructed on the public lands. Because of the intermingled ownership pattern the development of the road system often requires cooperation with adjacent landowners to insure access to the local, state and Federal highways that lead to the manufacturing centers. While the Bureau roads serve other forest values and uses, the cost of their construction and maintenance is usually carried by the timber sale contract. Consequently, in these instances, the time of construction is scheduled in conjunction with the sale of a given tract of timber. Following the completion of road construction they can be used jointly for protection and other activities associated with the timber management program in addition to timber harvest activities.

The width of these roads vary with the type of use, topography and other variables, however, in general they range from 14 to 20 feet in usable width and 40 to 100 feet across the cleared area. Not all roads are part of the permanent road network, some are used for a given period of time and then abandoned. Current plans call for the construction of approximately 500 miles of road a year, 400 of which will be loacted in western Oregon.

The operational practices associated with the development of the transportation system are included under the construction can be raised and lowered. Equipped in this manner a tractor can push material from place to place and shape the ground. Tractors can also be attached to scrapers for excavation and short hauls, however, trucks or self-propelled scrapers are usually used when earth is to be moved any distance.

(c) Embankment. This practice represents the construction of roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or adjacent to the roadway; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the roadway area. When available excavation material is not sufficient for the embankments, borrow material from outside must be brought in.

Embankments are constructed in layers; the thickness of which varies. Compaction of each layer is by steel rollers, rubber-wheel rollers, sheepsfoot rollers, etc. which may be self-propelled or towed by a tractor.

(d) Finishing. This practice is performed primarily by a motor grader and includes such items as trimming and finishing of slopes and the fine grading operations required to bring the subgrade to the final desired elevation.

(e) Based and Surface Courses. This treatment consists of all or part of a flexible pavement which is usually made up of a wearing surface, bases and subgrade. The wearing surface is an environmental impact analysis has been made of this operation entitled, "Operations of the Smith River Log Dump as Related to Water Quality and Aquatic Resources," October 1972, it will not be included in this statement.

The dominant transportation medium currently in use is the hauling of logs by trucks over roads constructed on the public lands. Because of the intermingled ownership pattern the development of the road system often requires cooperation with adjacent landowners to insure access to the local, state and Federal highways that lead to the manufacturing centers. While the Bureau roads serve other forest values and uses, the cost of their construction and maintenance is usually carried by the timber sale contract. Consequently, in these instances, the time of construction is scheduled in conjunction with the sale of a given tract of timber. Following the completion of road construction they can be used jointly for protection and other activities associated with the timber management program in addition to timber harvest activities.

The width of these roads vary with the type of use, topography and other variables, however, in general they range from 14 to 20 feet in usable width and 40 to 100 feet across the cleared area. Not all roads are part of the permanent road network, some are used for a given period of time and then abandoned. Current plans call for the construction of approximately 500 miles of road a year, 400 of which will be loacted in western Oregon.

The operational practices associated with the development of the transportation system are included under the construction can be raised and lowered. Equipped in this manner a tractor can push material from place to place and shape the ground. Tractors can also be attached to scrapers for excavation and short hauls, however, trucks or self-propelled scrapers are usually used when earth is to be moved any distance.

(c) Embankment. This practice represents the construction of roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or adjacent to the roadway; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the roadway area. When available excavation material is not sufficient for the embankments, borrow material from outside must be brought in.

Embankments are constructed in layers; the thickness of which varies. Compaction of each layer is by steel rollers, rubber-wheel rollers, sheepsfoot rollers, etc. which may be self-propelled or towed by a tractor.

(d) Finishing. This practice is performed primarily by a motor grader and includes such items as trimming and finishing of slopes and the fine grading operations required to bring the subgrade to the final desired elevation.

(e) Based and Surface Courses. This treatment consists of all or part of a flexible pavement which is usually made up of a wearing surface, bases and subgrade. The wearing surface is usually made up of a macadam, bituminous surface treatment or gravel surface and must withstand wear, abrasion and displacement from vehicles and prevent water from entering the base of the roadway. The bases are usually constructed of gravel or crushed rock and are layers of very high stability and density. The subgrade is the natural earth surface. In the usual instance it is the compacted soil in a cut section or the upper layer of an embankment section. Stone for use in the bases and surface course in obtained from nearby quarries or crushing plants.

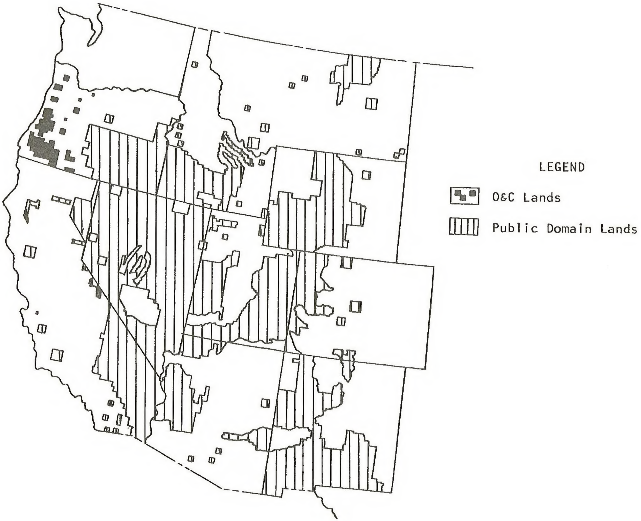
(f) Structures. These consist primarily of bridges, culverts, cattleguards, fences, retaining walls, guardrails and riprap. These structures may require excavation, embankment, concrete work, backfilling, or other construction operations.

(2) Maintenance [37-40] This phase includes the necessary repairs to keep a road in a safe, serviceable condition for use by logging trucks and passenger cars. These repairs include blading road surfaces, replacing and patching road surfaces, cleaning and replacement of culverts, cleaning ditches, replacing traffic signs, repairing bridges, brush and snow removal, slide removal and repairing settlements and washouts. Many of these repairs are necessitated by sudden failures, damage by stroms, gradual deterioration, and occasional obstructions.

(a) Surface Maintenance. Dirt road maintenance is primarily blading and leveling and clear~~n~~ing out of the side ditches and culverts.

FIGURE NO. 1

LAND ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT



usually made up of a macadam, bituminous surface treatment or gravel surface and must withstand wear, abrasion and displacement from vehicles and prevent water from entering the base of the roadway. The bases are usually constructed of gravel or crushed rock and are layers of very high stability and density. The subgrade is the natural earth surface. In the usual instance it is the compacted soil in a cut section or the upper layer of an embankment section. Stone for use in the bases and surface course in obtained from nearby quarries or crushing plants.

(f) Structures. These consist primarily of bridges, culverts, cattleguards, fences, retaining walls, guardrails and riprap. These structures may require excavation, embankment, concrete work, backfilling, or other construction operations.

(2) Maintenance [37-40] This phase includes the necessary repairs to keep a road in a safe, serviceable condition for use by logging trucks and passenger cars. These repairs include blading road surfaces, replacing and patching road surfaces, cleaning and replacement of culverts, cleaning ditches, replacing traffic signs, repairing bridges, brush and snow removal, slide removal and repairing settlements and washouts. Many of these repairs are necessitated by sudden failures, damage by stroms, gradual deterioration, and occasional obstructions.

(a) Surface Maintenance. Dirt road maintenance is primarily blading and leveling and clear~~n~~ing out of the side ditches and culverts.

FIGURE NO. 1

LAND ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT

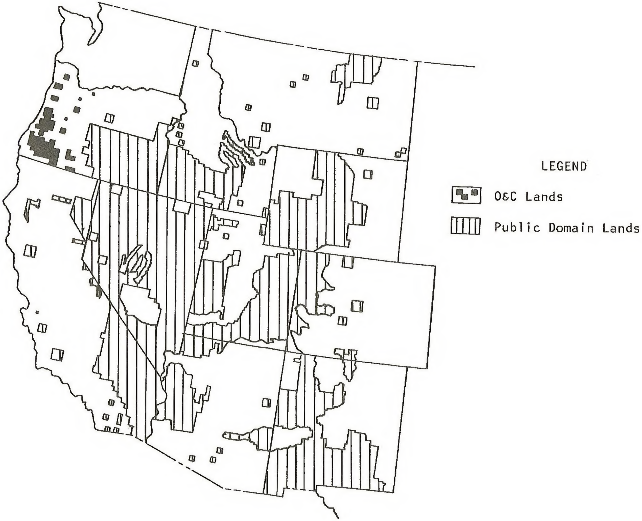
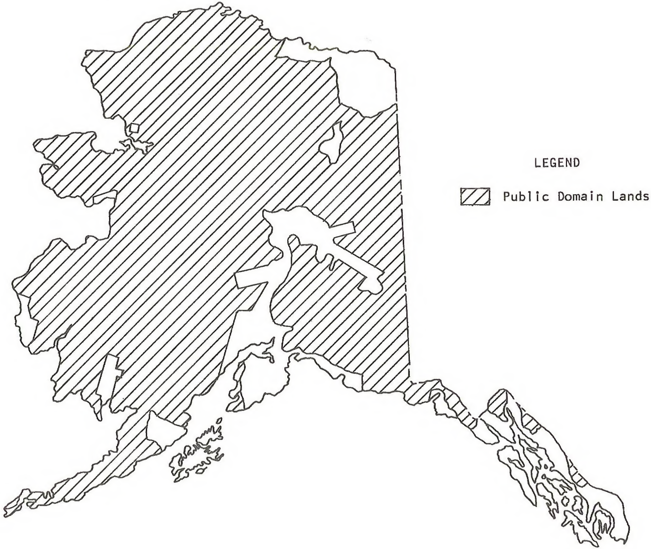


FIGURE NO. 2

ALASKAN LANDS ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT



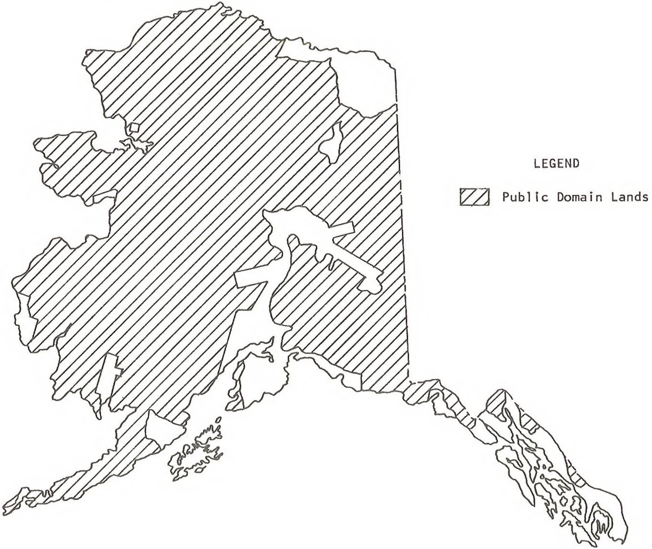
strip stretching from Portland to Astoria and McMinnville. A grant was also made to the State of Oregon for the construction of a wagon road from Coos Bay to Roseburg. This grant consisted of three alternate sections per mile in a strip extending three miles on either side of the proposed route and an additional indemnity grant extending three miles on either side of the initial place grant. The State transferred this grant to the Southern Oregon Company, its agent for construction of the road.

These three grants included a "settlers clause", as an accommodation to individual settlers, which set forth the terms which the grantees had to follow in disposing of any of the granted lands. In 1915, the Supreme Court held that the terms of the clause had been violated but left to Congress the question of appropriate action. Congress responded by passing the 1916 O&C Revestment Act which returned 2,890,893 acres of the original railroad grants to the Federal Government. Three years later Congress passed a similar act returning 93,000 acres of the Coos Bay Wagon Road Grant.

Under these acts the revested acreage was to be classified as power site, timber, and agriculture with the proviso that any timber harvested be sold by competitive bid. Agricultural land, which included timber and power site land from which the timber was removed, was subject to homesteading. This was a continuation of the philosophy favoring agricultural development by means of public land disposal. Because of the high elevation, steep slopes and unsuitable soils for farming that characterize much of the revested lands, a negligible

FIGURE NO. 2

ALASKAN LANDS ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT



strip stretching from Portland to Astoria and McMinnville. A grant was also made to the State of Oregon for the construction of a wagon road from Coos Bay to Roseburg. This grant consisted of three alternate sections per mile in a strip extending three miles on either side of the proposed route and an additional indemnity grant extending three miles on either side of the initial place grant. The State transferred this grant to the Southern Oregon Company, its agent for construction of the road.

These three grants included a "settlers clause", as an accommodation to individual settlers, which set forth the terms which the grantees had to follow in disposing of any of the granted lands. In 1915, the Supreme Court held that the terms of the clause had been violated but left to Congress the question of appropriate action. Congress responded by passing the 1916 O&C Revestment Act which returned 2,890,893 acres of the original railroad grants to the Federal Government. Three years later Congress passed a similar act returning 93,000 acres of the Coos Bay Wagon Road Grant.

Under these acts the revested acreage was to be classified as power site, timber, and agriculture with the proviso that any timber harvested be sold by competitive bid. Agricultural land, which included timber and power site land from which the timber was removed, was subject to homesteading. This was a continuation of the philosophy favoring agricultural development by means of public land disposal. Because of the high elevation, steep slopes and unsuitable soils for farming that characterize much of the revested lands, a negligible amount reverted to private ownership for homesteading purposes. The O&C Act of 1937 specified that all revested lands classified as timber land would be managed for permanent timber production, which in effect, stabilized the tenure of the lands so classified except for exchange purposes as subsequently authorized under the Act of July 31, 1939. Today, the O&C lands consist of approximately 2.2 million acres in a checkerboard pattern, the preponderance of which, represent the highest timber producing lands under the Bureau's administration and some of the most productive timber lands in the nation.

G. History of Organizational Structure

The Constitution of the United States gave Congress authority to administer the public domain lands. However, Congress was forced to look at the public domain as a source of revenues through land disposal actions since its financial resources were minimal and debts were high. In 1812 Congress established the General Land Office as part of the Treasury Department. The Land Office was authorized to survey, manage, and dispose of public domain lands primarily to encourage private settlement and development. Executive and administrative responsibilities were transferred from the Secretary of the Treasury to the Land Commissioner, with limited resource management authority. In 1849, the Department of the Interior was created. Originally called the Home Department, it was the sixth agency with cabinet status. The General Land Office, Office of Census, and Office of Indian Affairs were brought together in the new agency.

The passage of the Taylor Grazing Act in 1934 resulted in the creation of the Grazing Service within the Department of the Interior, with administrative responsibility for the management of the public domain lands of western United States. Shortly afterwards in 1938, the Oregon and California Revested Land Administration was organized as a division of the General Land Office with administrative responsibility for revested lands in western Oregon, generally referred to as the O&C lands. In 1946, the General Land Office and the Grazing Service were combined into a new agency called the Bureau of Land Management under the Department of the Interior, with administrative jurisdiction for both the public domain and O&C. With the end of World War II there began a period of accelerating mobility of the American people and an increasing appreciation of the resource values of the public lands. To cope with the new situation the Bureau started profound changes in its structure, personnel and approaches. Personnel programs emphasized professionalism.

Today, the Bureau has a total organization of approximately 3,700 people, most of which are located in offices in the western United States representing a variety of professional and non-professional disciplines. Professional foresters in conjunction with wildlife biologists, fisheries biologists, recreation specialists, hydrologists, soils specialists, economists and related professional expertise are currently directly involved in the management of the forest lands under the Bureau's administration.

H. History of the Timber Management Program

In the early development of public lands, beginning in the latter part of the 18th Century, no special consideration was given to the trees on the land, except for the reservation of small tracts of timber to be used for the construction of the Navy's sailing ships. Land was conveyed along with the timber to the settler, purchaser, or grantee, who often considered the forest as a nuisance to agricultural development rather than as a valuable natural resource. The forest lands remaining in public ownership were treated as a commons and trees were taken as needed for housing and fuel.

With the increasing pace of industrialization and the growth of urban communities in the East, the public forests became increasingly attractive to large-scale commercial exploitation and settlement. The taking of timber in trespass became increasingly large-scale, along with the emphasis on the rapid disposal of the lands. As the extent of the devastation of the great American forests became widely recognized, the future of the forests became a subject of public controversy. Congressional response was the Forest Reservation Act of 1891 which eventually led to the establishment of the National Forests, under the administration of the Forest Service. Lands outside the National Forests and other reservations (such as the National Parks) remained largely unmanaged and unprotected. Generally, the situation remained unchanged until the mid-1930's when the President reserved all remaining public lands outside of Alaska (about 200,000,000 acres) for classification and in connection with the development of National land use policies. Specific authority with respect to timber, with the exception of the O&C lands, was generally limited to a few statutes authorizing free-use of timber and authority to sell "dead and down" timber. A principal timber activity of the General Land Office was policing of timber trespass. Because of the small staff available for the work, the activity was largely limited to trying to collect damages for timber trespasses which could be discovered and traced.

It was not until the 1940's and 1950's that a ~~con~~concerted effort was made to utilize the timber resource found on the public lands. This period generally marked the beginning of the Bureau's current timber management program as described previously.

I. Interrelationships with Other Programs

The Bureau of Land Management administers approximately 450 million acres of National Resource Lands, located primarily in the western United States. These lands include a diversity of resource values and uses such as wildlife, livestock grazing, timber, minerals, water, recreation, and cultural sites. Additionally, the Bureau has certain responsibilities in the management of the mineral resources on other Federal lands; private lands where the Federal Government has retained subsurface rights; and the outer continental shelf.

The National Resource Lands are managed under the principal of multiple-use consistent with the many laws, statutes and regulations governing the protection and development of the nation's resources thereon. The laws include the Federal Water Pollution Control Act, Clean Air Act, Endangered Species Act, Fish and Wildlife Coordination Act, Bald Eagle Protection Act, Sikes Act, National Environmental Policy Act, National Historic Preservation Act, Historic Sites Act, Taylor Grazing Act, Federal Environmental Pesticide Control Act and others. To help meet its legislative requirements the Bureau utilizes a systematic process for the development of land use plans on which individual resource programs are based. These programs relate to wildlife habitat improvement, protection of rare and threatened species, preservation of historical and archaelogical sites, timber production, environmental protection, the use of off-road-vehicles, construction of recreational sites and facilities, watershed development projects, road construction and access acquisition, fire protection, soil conservation, mineral exploration and development, wild horses and burro management, livestock grazing and others. While most of the programs are not simultaneously carried out on the same acre of ground many are often carried out simultaneously in different parts of a relatively small area. Quite often many of these programs are compatible with one another, however, in other instances they are in conflict thereby requiring the exclusion of one or more potential programs in deference to a higher priority program. Priorities, in turn are based on public needs and specific legislative mandates. An overriding consideration is determining the appropriate program or mix of programs to be carried out and how they are to be carried out on a particular area is the protection or enhancement of such basic environmental components as soil, air and water.

All of the foregoing factors directly affect the shape and magnitude of the timber management program since forested lands provide many of the necessities or amenities that society demands in addition to those associated with the production of wood. The forested lands under the Bureau's administration are particularly significant in terms of scenic values, recreational opportunities, wildlife, watersheds, and providing habitat for certain endangered and threatened species. The timber management program reflects these and other values because of their consideration both in determining what lands are to be available for the production of wood and the manner in which the timber management practices are to be carried out on lands that are available. Consequently, timber production is only one of the many resource activities that comprise an integrated forest management program.

Another dimension to the planning and implementation of the timber management program involves coordination with other Federal agencies, State and local governments and the private sector. This is particularly essential due to the intermingled ownership pattern which characterizes the areas where the National Resources Lands are located. Most of the adjacent lands, particularly in western Oregon, are in private forest holdings which are subjected to a diversity of timber management practices consistent with individual or corporate objectives and policies. The actions taken by the private sector on their lands can have a significant influence on the resources found on the National Resource Lands as well as contributing to the cumulative impact of timber management on a given watershed or area. Consequently, cooperation and coordination between the Bureau and the appropriate parties is sought in the course of planning and carrying out the Bureau's program in order to minimize cumulative environmental impacts.

Joint planning is also carried out where National Resource Lands are adjacent to National Forests or state forests. The three public ownerships generally have comparable timber management programs since they are managed under the principles of sustained yield, multiple use and environmental protection. Current national cooperative agreements between the Bureau and Forest Service relate to matters that include pest control, fire control, forest insect and disease surveys, land withdrawals and forest roads, integrated timber sales and road maintenance and construction. Where regional plans have been developed by State, local or other entities, they are also utilized in the formulation of the many diverse but interrelated resource programs carried out on Bureau administered forests.

Bibliography

1. BLM, An Allowable Cut Plan for Western Oregon, March 1970.
2. BLM, The Uncertainty of Interior Alaska Timber Resource Development Implications for BLM Program Directions, May 1971.
3. BLM, Public Land Statistics, U.S. Government Printing Office, Washington, D.C., 1972.
4. BLM Manual 5240, Allowable Cut Planning, March 22, 1972.
5. BLM Information Memo No. 72-45, March 10, 1972, Timber Management Program.
6. BLM Manual 5700.01 (Draft Revision submitted to Washington Office by Oregon State Office).
7. BLM, An Allowable Cut Plan for Western Oregon, March 1970, pg. 25.
8. Smith, David Martyn, The Practice of Silviculture, Seventh Edition, pg. 84.
9. Keen, E.P., Insect Enemies of Western Forests, U.S. Government Printing Office, Washington, D.C., 1952, pg. 217.
10. Anderson, R.F., Forest and Shade Tree Entomology, J. Wiley & Sons, 1966, pg. 53.
11. Ibid., pg. 56.
12. Boyce, J.S., Forest Pathology, McGraw-Hill Book Co. Inc., 1961.
13. Toumey, James W., Foundations of Silviculture, John Wiley & Sons, Inc., New York, 1947, pg. 319-321.
14. Society of American Foresters, Forest Terminology, 1958, pg. 21, 22 (all under Methods of Cutting).
15. Ibid., pg. 22.
16. Ibid., pg. 87.
17. BLM, An Allowable Cut Plan for Western Oregon, March 1970, pg. 18.
18. Forest Terminology, pg. 21 (14. and 15. under Methods of Cutting).
19. Ibid., pg. 22 (26. under Methods of Cutting).
20. Ibid., pg. 21 (7. under Methods of Cutting).

21. Ibid., (1. under Methods of Cutting).

22. Ibid., (17. under Methods of Cutting).

23. Ibid., (18. under Methods of Cutting).

24. Ibid., Pg. 22 (26. under Methods of Cutting).

25. BLM, Plan for Time and Cost Study of Light Yarder - Loader Logging - Part One, 1969.

26. BLM, Logging, Transportation and Contractural Costs - Schedule 16, 1970, pg. 32C9, Table 38, and Appendix 1, pg. 161, 166.

27. Binkley, Virgil W., An Engineering Evaluation of Skyline - Crane Logging Systems, U.S. Forest Service, PNW, 1961 - unpublished report, pg. 3.

28. Lysons, Hilton H., Grapple Yarding Revolutionized Logging, reprint from Logging Issue of Western Conservation Journal (undated).

29. Mann, Charles N., Balloon-Running Skyline System, U.S. Forest Service paper presented to FAO Symposium on Forest Operations in Mountainous Regions at Krasnodar, U.S.S.R., August-September 1971, pg. 2.

30. Ibid., pg. 3.

31. Ibid., pg. 2.

32. Ibid., pg. 5, 6.

33. Newport, Carl (consulting forester with Mason, Bruce and Girard - Portland, Oregon), Necessary Conditions for Helicopter Yarding on Public Forest Land (briefing paper - 1970), pg. 1.

34. Brown, Nelson C., Logging, John Wiley & Sons, Inc., New Yrok, 1958, pg. 129-130.

35. Merritt, F., and C.H. Sain, Earthwork Standard Handbook for Civil Engineers, McGraw-Hill, New York, 1960, C 13, pg. 1.

36. Ritt, L.J., and R.J. Paguette, Highway Engineering, Ronald Press Co., 1960, pg. 348.

37. BLM, 9113.71C, Timber Sale Responsibility, 9110 Road Manual.

38. Ritter, Leo J., and Radnor J. Paquette, Highway Maintenance, HIGHWAY ENGINEERING, New York, 1960, The Ronald Russ Company, pg. 690-721.

39. BLM 9113.7 Maintenance, 9110 Road Manual.

40. Maintenance Management, NATIONAL ASSOCIATION OF COUNTY ENGINEERS ACTION GUIDE SERIES, 1972, Cedar Rapids, Iowa, pg. 30.

41. Public Land Law Review Commission Report, One-Third of the Nation's Lands., U.S. Government Printing Office, Washington, D.C. 1970, pg. 19.

42. Ibid., pg. 28.

43. Ibid., pg. 22.

II. DESCRIPTION OF THE ENVIRONMENT*

A. Geographic Location

Due to the location of the lands under the Bureau's administration timber management is limited to the Coniferous Forest Biome, which generally extends from the western edge of the grasslands in the Great Plains to the Pacific Ocean, including the major part of Alaska. A biome may be defined as a major biotic community; that is, natural groups of organisms characterized by the occurrence of certain plants and animals which are dominant and influential.[1] International Biome Programs have been initiated to analyze basic ecosystems and among other goals to establish a scientific base for programs to maintain or improve environmental quality.[2] Sharp demarcation lines between biomes have not yet been developed. Therefore, to utilize the basic advantages of the biome approach, and collect, analyze and recommend on the numerous effects of timber management organizational biome boundaries will include both aquatic and terrestrial communities.

The Coniferous Forest Biome represents a diversity of environments, species compositions, soils, resource products and land uses under greatly varying climatic conditions. This Biome has been broken down into three sub-biomes in an attempt to delineate and further homogenize the many environmental variations within the coniferous forest.

---

* Consistent with Departmental and Bureau Manuals this Chapter describes the environment as it exists today. However, since timber management has been an ongoing Bureau Program for many decades, it reflects, in part, the effects of the program and therefore does not fully comply with the requirement that the existing environment be described without the action. The additional requirement for describing the probable future environment without the action is met in Chapter VIII, Alternatives, where the no timber management program is discussed.

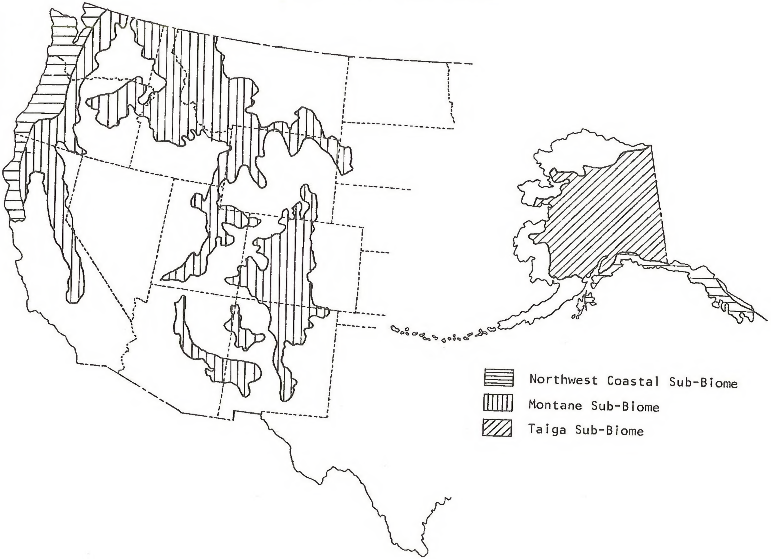
These sub-biomes are as follows (see also Figure 3):

- Taiga Coniferous Forest. This forest spreads across interior Alaska with narrow fingers following waterways into the Arctic
- Montane Coniferous Forest. This forest generally extends eastward from the crest of the Cascade Mountains to the eastern foothills of the Rocky Mountains and southward from Canada to Mexico. At approximately 43°N latitude, it extends westward into southwestern Oregon to include all but the western slope of the Siskiyou Mountains. From the Siskiyous it extends southward encompassing the Klamath Mountains and east slopes of the Coast Range of California.
- Northwest Coastal Forest. Primarily a rain forest, it generally extends southward along the Pacific Coast from southern Alaska through western Washington and Oregon and eastward to the crest of the Cascade Mountains. At approximately 43°N latitude, it constricts to a much narrower band along the west slope of the southern Oregon and California Siskiyou and Coast Range Mountains.

For each component of the environment described in the parts that follow the various characteristics common to all three sub-biomes (the Coniferous Forest Biome) are discussed and also the characteristics unique to a particular sub-biome are described, when applicable.

FIGURE NO. 3

CONIFEROUS FOREST BIOME



B. Ecological Interrelationships

A description of the ecosystem must concern itself with the forest as a biological community, with the interrelationships between the trees and other organisms comprising the community, and with the interrelationships between these organisms and the physical environment in which they exist.[3] In order to systematize the description of the forest ecosystem the physical environment and the biotic community will be briefly discussed separately in the first parts that follow. However, it should be understood that these components of the ecosystem are not independent but rather interdependent and interrelated influences that must in the final analysis be considered together, as they will be in the later parts.

1. General Physical Environment

The physical aspects of the forest ecosystem constitute the sum total of the atmosphere, soil and water components, each of which contributes to sustaining the life of the biotic community. In the case of vegetation, the plant grows with its crown in the atmosphere and its roots in the soil. To the crown comes the warmth, light carbon dioxide and oxygen; and to the roots come the mineral nutrients and water necessary for the life processes. Their availability depend upon an endless system of changing climate, day length, and soil development - changes that are in part related to the developing vegetation itself.[4] The physical factors that affect plant and animal life can be divided into broad groups as follows:

- Above the surface. These climatic factors include solar radiation, precipitation, air temperature, air humidity, wind, lightning, and carbon dioxide content of the air.
- Below the surface. Geologic and soil factors include the nature of the parent material, the soil profile, physical and chemical soil properties and soil moisture relationships.
- On the surface. Includes the land forms and the standing or running water which provides nutrients and the immediate physical environment for aquatic plants and animals.

2. General Biotic Community

The forest is made up of organisms, both plant and animal, mutually occupying a complex of environments which are dominated by trees and other woody vegetation. All of the organisms are in competition for the physical components of light, air, water, warmth and nutrients necessary for life.[5] Each in its turn creates part of the environment affecting the others. These organisms can be classified in terms of the basic functions they perform in the community:

- Producers. These are largely the green plants that assimilate the nutrient minerals by the use of considerable energy and combine them into living organic substances. They include flowering plants, gymosperms, mosses, ferns, liverworts, multicellular green algae, red and brown algae.

- Consumers. These are chiefly animals that eat and digest organic matter, releasing considerable energy in the process. They include mammals, birds, reptiles, fish, insects, roundworms, flatworms, and parasitic fungi and bacteria.
- Reducers. These are chiefly bacteria and fungi that return complex organic compounds back to the original abiotic mineral condition, thereby releasing the remaing chemical energy. These include micro and macro-organisms such as millipedes, earthworms, mites, fungi and bacteria.

3. Typical Coniferous Forest Biome Ecosystem

Combining the physical environment with the biotic community, the forest ecosystem becomes a complex of trees, shrubs, herbs, bacteria, fungi, protozoa, arthropods, other invertebrates of all sizes, sorts and description, vertebrates, oxygen, carbon dioxide, water, minerals, and dead organic matter that in their totality constitute the forest.[6] The ecosystem is constantly changing diurnely, seasonally and over the long-term climatic cycles. Change is perpetual and goes on at a rapid or gradual rate depending upon the rate of changes in the climate, the soils, the land forms, the fire history and the biotic composition of the ecosystem.[7]

When the environment changes as a result of the actions of organisms so that there is an increas in soil fertility, decrease in light intensity, or some other modification, conditions may become more favorable for some other species than for those already present. There may then be a replacement of one species by another or of one community by another, and this second community may be replaced by a third, and so on. Thus, succession of easily recognized stages takes place in the development of a climax community. The final stage or climax tends to persist as long as there is no change in climate or as influenced by the actions of man.[8]

The interrelationships between and within the physical environment and the biotic community can be described in terms of the following integrated processes, each of which is vital to sustaining life in the forest, and in turn its value to the public.

a. Nutrient Cycle

Vegetation is the basic nutrient producer since, through the process of photosynthesis, it converts inorganic chemicals to a simple form of sugar known as glucose. Using water and minerals from the soil, carbon dioxide from the air, and sunlight, this process links nearly all living organisms with the sun, the earth's ultimate source of energy. A by-product of this process is oxygen. By means of further chemical changes, all of which take place in plants and some of which take place in animals, the basic sugar is converted into more complex carbohydrates proteins, fats and other substances that support life.[9]

These nutrients, as well as others, continuously circuate through the ecosystem following fixed patterns or cycles and in the process are made available in various forms to animals. The plant eating animals constitute the first order of consumers, some of which are subsequently consumed by predator type animals or lived-off by parasitic type animals, who in turn may be consumed by scavengers.

When plant litter, averaging 3000 - 5000 pounds per acre annually, or plants and animals die and fall to the forest floor, the billions of decomposers convert their remains into inorganic substances. These include nitrogen, phosphorous, potassium and calcium which are the chemicals most often in short supply in the forest soil.[10] They are then, along with others, taken up by the plants through the root system, with the assistance of mycorrhizal-forming fungi, thus beginning the cycle again, or stored in the soil. Nitrates, if not looped back through the plants or stored in the soil, are denitrified and the nitrogen is returned to the atmosphere where it is available to nitrogen-fixing plants such as certain species of algae.

Forests are unique compared to other biomes in that a large amount of nutrients is stored in the trees for relatively long periods of time prior to being made available for recycling. Forest ecosystems cannot be patterned as typical food chains; trees are not usually palatable. Under natural conditions they are decomposed by micro-organisms or destroyed by fire. In managed forests, they are removed to a great extent from the system.

b. Energy Flow

The transmission of energy through the forest ecosystem is closely correlated to the nutrient cycle, however, unlike the process energy is not recycled. Virtually all energy enters the biotic community as sunlight, but only 1 percent of the light that falls on the forest is transformed by green plants into the chemical energy of food. The remainder is reflected from the leaves, transmitted through them, or dissipated as heat.

Food manufactured by green plants is subsequently passed through the tissues of the plants, plant-eaters, predators, scavengers, parasites, saprophytes and other consuming and decomposing forms of animal life. In each group, some of the food is used to build tissue and some as fuel for bodily processes, growth, reproduction, and movement. The chemical energy of the food fuel is converted, through respiration, to heat energy that is lost to the air. Some energy is also lost in food eaten by foraging animals that do not live in the forest, by animals that leave when mature, by fires and by the removal of vegetation and game animals by man.[11]

Once energy is transformed from a stored form (in food or body tissue), to some active form (heat), it dissipates in the atmosphere and is lost to the biotic community. Life continues by virtue of the continuous influx of new energy as a result of solar radiation.

c. Hydrologic Cycle

Both the nutrient cycle and the energy flow depend in large measure upon the water cycle which controls the availability of nutrients to plant roots, their rate of movement through the plant, the conditions under which plant litter is decomposed, and the development of the soil profile which affects the availibility of nutrients to the plant roots as recycling is initiated.[12] Thus, the hydrologic cycle constitutes a vital part of the forest ecosystem in supporting vegetation, and in turn the entire biotic community.

The cycling of water in the ecosystem consists essentially of precipitation inputs from the atmosphere, runoff outputs in the form of streamflow, and a series of intermediate processes influencing the magnitude of the precipitation/runoff relationship. These include interception, infiltration and percolation through the soil, evaportranspiration, surface runoff and storage at various levels of the system. Consequently, the nature of the biotic community is both a function of the hydrologic cycle and, in turn, a major influence on it.

4. Ecological Variations

The foregoing physical and biotic components of the forest ecosystem and their basic interrelationships are common to the entire Coniferous Forest Biome. However, because of regional differences, primarily climatic, their make-up or nature varies between sub-biomes and warrants discussion.

- Taiga Coniferous Forest. Due to low temperatures and a short growing season the Taiga is the least productive in terms of the biomass of the biotic community. Despite long summer days, the annual growth rate of vegetation is low and regrowth when disturbed can be extremely slow. Temperature exerts such a powerful limiting effect that only a relatively few kinds of organisms have successfully adapted to far northern conditions.[13] Thus, the entire living part of the ecosystem is built around relatively few species.

Basic relationships are simplified. The soil surface is charaterized by a thick, spongy mat of living and undecayed vegetation (reduction by bacteria is very slow because of low temperatures), often saturated with water and dotted with ponds.[14] The soil depth is relatively shallow due in part to the underlying permafrost. Because of these and other limiting factors, there is a low rate of nutrient turnover and energy flow. Ecosystems like the Taiga, containing species of plants with low growth rates and animals with low reproduction rates, are generally fragile.[15]

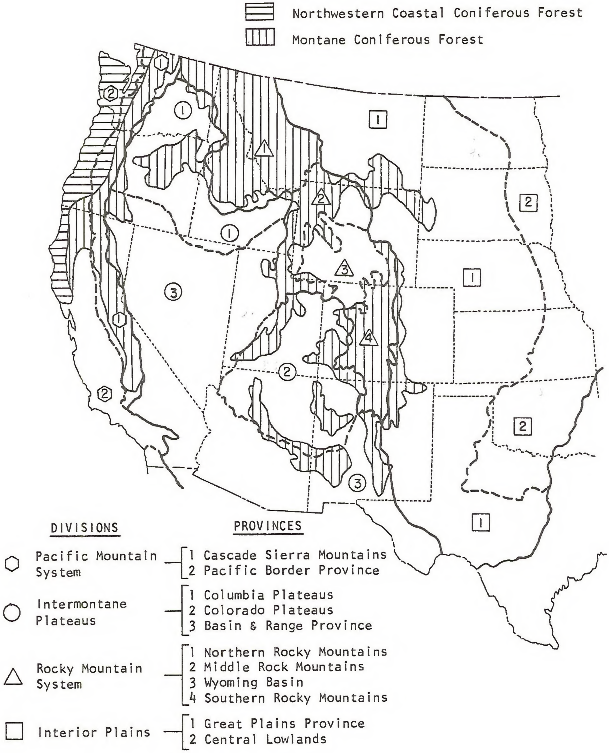
- Northern Coastal Coniferous Forest. Due to favorable climatic conditions, the Northwest Coastal Forest is highly productive in terms of the biomass of the biotic community, particularly in the "standing crop" of producers. Unlike the drier sub-biomes, the precipitation/evaporation ratio is extremely favorable and the understory vegetation is well developed wherever any light filters through. Trees in conjunction with the abundant lower levels of vegetation combine to provide a thick layer of organic litter to be broken down by bacteria, weighing as much as 1500 pounds per acre, and other decomposers. The numbers of biotic species and respective populations for the trophic levels, i.e., producers, consumers and decomposers, are relatively high resulting in a complex but productive ecosystem. Natural succession of plant life is rapid following surface disturbance.
- Montane Coniferous Forest. The Montane has a fairly high annual production rate despite the low temperatures that prevail over most of it during half the year. The soil contains a fair

population of small organisms but comparatively few larger ones. Consequently, the rate of litter decay is slower in the Montane than in the Northwest Coastal Forest and in conjunction with other factors, is less productive in terms of biomass. The higher elevational zones, supporting alpine trees and meadows, have a short growing season and becuase of soil and related conditions are fragile in nature. Generally, the lack of moisture during the growing season represents the major limitation in the nutrient-energy-water components of the ecosystem.

C. Physiography and Geology

A physiographic classification is based on those gelogic processes acting on different rock types and rock structures which erode at different rates to form regions separated by recognizable boundaries.[16] The Coniferous Forest Biome of the Western United States and Alaska lies within four major physiographic divisions: (1) the Interior Plains, (2) the Rocky Mountain System, (3) the Intermontane Plateaus, and (4) the Pacific Mountain System. These major divisions are further subdivided into provinces. The Coniferous Forest Biome of the Western United States and Alaska covers portions of these provinces: (Fig. 4 & 5)

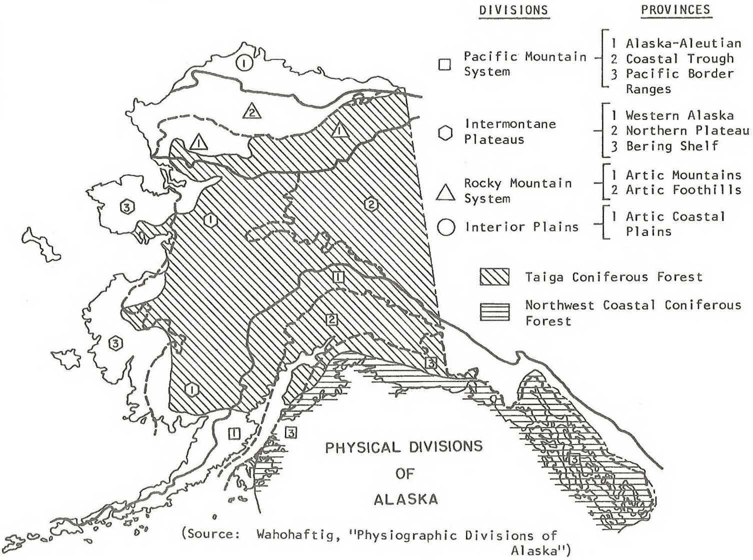
PHYSICAL DIVISIONS OF THE UNITED STATES


▤ Northwestern Coastal Coniferous Forest
▥ Montane Coniferous Forest
1
2
1
1
1
2
2
1
3
3
1
4
2
2
2
3
1

DIVISIONS	PROVINCES
⬡ Pacific Mountain System	1 Cascade Sierra Mountains 2 Pacific Border Province
○ Intermontane Plateaus	1 Columbia Plateaus 2 Colorado Plateaus 3 Basin & Range Province
△ Rocky Mountain System	1 Northern Rocky Mountains 2 Middle Rock Mountains 3 Wyoming Basin 4 Southern Rocky Mountains
□ Interior Plains	1 Great Plains Province 2 Central Lowlands

FIGURE NO. 4

FIGURE NO. 5



PHYSICAL DIVISIONS OF ALASKA

(Source: Wahohaftig, "Physiographic Divisions of Alaska")

Major Division	Province
Interior Plains	Great Plains Province Arctic Coastal Plain Province
Rocky Mountain System	Southern Rocky Mountains Middle Rocky Mountains Northern Rocky Mountains Arctic Mountains Province
Intermontane Plateaus	Columbia Plateaus Colorado Plateaus Northern Plateaus Province Western Alaska Province
Pacific Mountain System	Pacific Border Province Cascade Sierra Mountains Alaska-Aleutian Province Coastal Trough Pacific Border Ranges

Since these divisions and provinces may extend into several subbiomes, the first portion of this section will describe the physiography and geology of the Coniferous Forest Biome that covers the Continental Western United States and the second part will describe the Coniferous Forest Biome covering Alaskan physiographic provinces.

1. Montane and Northwest Coastal Coniferous Forest (Excluding Alaska)

a. Interior Plains

(1) Great Plains Province - Physiography. Eastern portions of the Montane Coniferous Forest lie in the Great Plains Province. The western boundary at the foot of the mountains averages 5500 ft. with a range of 1000 ft. above and below that altitude. The eastern boundary lies between the 1500 and 2000 ft. contour. This indicates a fall in slope to the east of about 10 ft. to the mile.

Erosion is more extensive along the margins, generally increasing towards the north. It is into this western portion along the Colorado Piedmont and Missouri Plateau that the Montane Coniferous Forest extends. The topography ranges from rolling hills in the southwest part, grading into mountains and glaciated terrain towards the northwest portions.

(2) Great Plains Province - Geology. The Great Plains Province lies within the central Stable Region, an area where major tectonic activity has been absent over much of geologic time. Rock types consist of a foundation of Pre-Cambrian crystalline rock, which is a continuation of the Canadian Shield, covered by a veneer of sedimentary rock. These sediments vary greatly in thickness from place to place, and several broad basins, arches and domes are present.[17] Unconformities in the sedimentary layers indicate the major trangressions and overlaps of prehistoric seas have occurred.

b. Rocky Mountains System

(1) Southern, Northern and Middle Rocky Mountain Provinces - Physiography. Much of the Montane Coniferous Forest covers the Rocky Mountain System. This great barrier of Mountains lies between the Interior Plains system on the east and the Intermontane Plateaus on the west.

The Northern Rocky Mountain Province differs from the Middle and Southern Rocky Mountain Provines in landform appearance. The Northern Province lacks the orographic units, i.e., the mountainous topography which are easily distinguished in the Middle and Southern Provinces. The ranges in the Middle and Southern Provinces are linear features with the main crest on structural uplifts flanked by outward-dipping strata making hogback foothills. In the Northern Province most of the larger mountain masses are not linear and don't have an axial crest or monoclinal foothills. They are more like extensive plateaus deeply carved by erosion.

Relief in the Northern Province ranges from 2000 to 5000 ft. from the valley floors and mountain crests.

Relief in the Middle Rocky Mountain Province varies from 500 feet in some of the narrow erosion valleys to greater than 3000 feet at the summits of some of the lofty peaks.

Within the Southern Rocky Mountain Province relief ranges between 3000 and 5000 feet. This Southern Province has 46 mountains in Colorado which rise above 14,000 feet, and 300 more to 13,000 feet. Most rise from 500 to 2500 feet above the surrounding level.[18]

(2) Southern Rocky Mountain Province - Geology. The Southern Rocky Mountain province consists of broad, elevated, north-south strips of granitic type rocks generally flanked by steeply dipping sedimentaries. The sediments often make foothills and locally cap the mountsin. In the southern part of the Province some of the mountains are made up of volcanic ejecta. Structurally these belts are large anticlines that have been deeply eroded.

(3) Middle Rocky Mountain Province - Geology. The Middle Province is separated from the Southern Province by the Wyoming basin. Rock types are similar to those found in the Southern Province. Most of the mountains have a granitic core flanked by sediments such as the Teton Range, which is a tilted fault block system. The Absoraka Range was formed by the accumulation of volcanics, mostly breccias. Much of the Yellowstone area is covered by lavas. Many of the mountains found within this Middle Province have been altered by glaciers.

(4) Northern Rocky Mountain Province - Geology. This Province is characterized by discordant, non linear mountain crests, mainly composed of igneous or metamorphic rocks, which are broken by occasional wide valleys with nearly flat or hilly floors filled with tertiary sediments. Within Idaho a great granitic batholith covering some twenty thousand square miles is exposed.

c. Intermontane Plateaus System

(1) Colorado Plateau Province - Physiography. The Colorado Plateau covers an area of approximately 130,000 square miles, characterized by badlands, high escarpments, deep gorges, and many strongly differentiated smaller plateaus.

The rocks exhibit a distinguishable pattern of horizontal bedding, dissected into hundreds of canyons, the largest of which is the Grand Canyon. Except for some of the canyon bottoms the plateau elevations lie between 5,000 and 11,000 feet, some of the plateaus being higher than the surrounding mountains. This Province generally overlooks its neighbors from a bold escarpment except to the north and east where it is bordered by high mountains.

(2) Colorado Plateau Province - Geology. The rock types making up the plateau are mostly thick bedded, horizontally layered, sedimentary rocks of Cretaceous to Tertiary age. Another significant type of structure in the Colorado Plateau Province is the laccolithic intrusion; a lens-shaped intrusivee body that has domed up the overlying sedimentary beds.[19] Several such intrusions have produced mountains on the plateau. The volcanic field is another important geologic feature that can be found on the Colorado Plateau, along the east, west and southern borders.

(3) Columbia Plateau Province - Physiography. The Columbia Plateau Province covers about 100,000 square miles in Washington, Oregon and Idaho. The topography consists of flat, rolling hills, horizontally layered lava flows, all of which are broken by many variations such as the Blue Mountains, incised valleys, dissected plateaus and broad alluvial terraces. The Columbia and Snake Rivers have cut deep gorges in many places.

(4) Columbia Plateaus - Geology. Lava flows make up most of the rocks in this Province, occurring in horizontally layered flows from 10 to 200 feet thick. The Snake River cuts through more than 4000 feet of basalts along the Western boundary of Idaho. Granitic rocks underlie the basalts in Southwestern Idaho, being part of the

Great Idaho batholith. Continental lake bed sediments occur in SE Oregon and SW Idaho. During the Pleistocene much of western Washington was altered by the effects of glaciation, leaving an area called "The Channeled Scablands" covered with Pleistocene and recent sediments.

d. Pacific Mountains System

(1) Cascade Sierra Mountains Province and Pacific Border Province - Physiography. The Northwest Coastal Coniferous Forest boundary lies within the Pacific Border Physiographic Province. This Province is characterized by a chain of mountains called the "Coast Ranges" including the Olympics, Oregon Coast Ranges, Klamath and the California Ranges. East of the mountains is a line of valleys including the Cowlitz, upper Chehalis, and Puget Sound Valleys in Washington, and the Willamette Valley of Oregon, which is cut off in northern California and southern Oregon by the Klamath Mountain Complex. Generally the northern part of the Pacific Border Province is expressed by peaks with similar elevations (accordant crests) and local alpine peaks; the central part by an uplifted peneplain (an eroded surface which has been uplifted by folding, faulting or intrusion) and the southern part by parallel ranges with rounded crests of subequal height.

The Cascade-Sierra Mountains Province which forms the eastern margin of the Pacific Mountain System constitutes a single Province but differs in character, between the north and south. The Montane Coniferous Forest boundary runs along the crest of the Cascade Range down to SW Oregon, then SW and down along the crest of the Coast Ranges.

It forms a single mountain barrier between the plateaus on the east and the valleys on the west. The length of the mountain ranges is more than a 1000 miles with an average width of 50 to 60 miles. Crest height varies but not over short distances. In the southern Sierras it ranges from 12,000 to 14,000 feet, with Mt. Whitney rising to 14,497 feet. The lowest average height is in the southern Cascade Mountains in northern California and southern Oregon. The province is narrowest at this place with high isolated mountains, and no continuous crests. From Mt. Whitney to northern California there is a gradual but not uniform decline in altitude. A 6000 to 8000 foot crest level is common farther north.

(2) Pacific Border Province - Geology. The geology of this province is diverse in character, varying from lowland troughs to broken coastal ranges.

The northern portion of this province is a partly submerged drainage system. Some of this area has been glaciated and is covered with glacial deposits overlying non-resistant geosynclinal sediments. A geosyncline is an elongated trough that will eventually form folded mountains. The coast ranges on this northern part are the result of an uplifted peneplain intruded by volcanics and partially carved by glaciers. Moving south the mountains grade from an uplifted peneplain on weaker Tertiary rocks, dissected, and with monadnocks (a mountain like mass such as a butte) of igneous rock rising above the adjacent topography. Farther south the mountains are composed of more complex, metamorphosed rocks uplifted and dissected with longitudinal drainage patterns. The California Coastal Ranges are the southern most range of mountains covered by the Northwest Coastal Coniverous Forest. Their general trend is NW with elevations ranging between 2000 and 4000 feet. The ranges and valleys are roughly parallel with rounded crests and have been folded and faulted. Most of the rocks are metamorphosed, including indurated sandstones, slate, and other resistant rocks.[20] Weaker sedimentary rocks occupy the structural troughs. Volcanic rocks are relatively absent from the area. Granite underlies much of the range.

The San Andreas Fault can be traced for 530 miles southeastward from Point Arenas at about latitude 39°.

(3) Cascade-Sierra Mountains - Geology. The Cascade Mountains geology is in contrast to that of the Sierra Mountains Complex.

The Cascade can be divided into the Northern Cascades and the Middle and Southern Cascades.

The Northern Cascades are covered with ancient sediments vastly older than the present topography, strongly folded and in part metamorphosed and intruded by granitic batholiths. Some granitic peaks such as Mt. Stuart occur irregularly as manodrocks. Glaciers have altered the topographic expression of many of the peaks.

Igneous-rock types in the Middle and Southern Cascades are mostly siliceous andesites. These congeal quickly after eruption to form a mountainous topography unlike the plateau basalts to the east which congealed slowly and flowed out the form plateau type landforms. Local accumulations of siliceous andesites were aided by eruption of fragmental products, bombs, lapilli, dust, and cinders and are in sufficient quantity to help determine topography.

The Sierra Nevada is a massive and continuous range extending from latitude 34°50' to latitude 40°20' a distance of about 400 miles. The massif is a tilted fault block, with a steep east-facing fault scarp. It has been submaturely dissected by deep valleys and the northern part has been glaciated. Three-fourths of the rocks are granitic in origin. North of latitude 37°20' about one-third of the rocks are sediments which have been metamorphosed and in part schistose. These beds have been closely folded. Further north, teritiary volcanics including lavas and tuffs were extruded near the crest of the range and flowed west in shallow valleys, displacing the streams. These rocks are in small proportions that those rocks making up the southern extent of the range.

2. Taiga and Northwest Coastal Coniferous Forests (Alaska)

a. Interior Plains

(1) Arctic Coastal Plain Province - Physiography. The Interior Plains System is the northern most physiographic division in Alaska. The Taiga covers the Northeastern part of the Arctic Central Plain Province. The Plain is smooth rising to a maximum altitude of 600 feet at its southern margin. Drainage is poor and during the summer the surface is marshy. There are no

glaciers but the entire area is underlain by permafrost at least 1000 feet thick. The base of the summer thaw zone is between 1/2 to 4 feet below the surface.

b. Rocky Mountain System

(1) Arctic Mountains Province - Physiography

This province is characterized by mountains, hills and lowlands, the highest peaks rising to elevations of 7000 - 8000 feet in the Brooks Range. Drainage patterns are diverse flowing north and south down the mountain slopes with the predominate drainage of the Brooks Range flowing south into the lowland areas. Glaciers have carved the rocks in the Brooks Range. Evidence of glaciation is expressed in sharp peaks and crested divides, cirques and a few tarns or glacial lakes. Small cirque glaciers are still present at the higher elevations in the central and eastern part of the range. Towards the west glaciers have carved the sedimentary rocks into cliff and bench slopes. The mountains to the west have rounded to sharp summits lower in elevation than the mountains to the east.

(2) Arctic Mountains Province - Geology. Most of the rocks making up the province are folded and over thrust Paleozoic and Mesozoic sedimentary rocks including limestone and shales and metamorphics including quartzites, slates and schists. Granite intrusions occur in the southwest part of the Brooks Range.

c. Intermontane Plateaus System

Most of the Taiga Coniferous Forest of Alaska covers this physiographic division. This system has been divided into the Northern Plateaus Province and the Western Alaska Province.

(1) Northern Plateaus Province, Western Alaska Province - Physiography. This province consists of uplands and lowlands carved by glaciers. The topography ranges from low ridges having gentle slopes, narrow valleys of low country consisting of low-rounded ridges and open valleys, basins, marshy lake dotted flats, and highland areas consisting of even-topped rounded ridges rising 2000 - 4000 feet in altitude surmounted by isolated areas of more rugged mountains, some as high as 5500 feet. Moraine-dammed lakes can be found in some of the glaciated mountain passes, thaw lakes and oxbow lakes cover some of the lowland areas along the Yukon River. Much of this province is drained by tributaries of the Yukon River. Permafrost covers most of the province but where discontinuous permafrost occurs periglacial mass-wasting develops at higher altitudes and frozen muck covers the valley bottoms during the summer months.

(2) Northern Plateaus Province - Geology. Crystalline schist, granite, quartzite, slate, and mafic igneous rocks, probably mostly Paleozoic in age, overlie deformed Paleozoic and Mesozoic sedimentary rocks in the Northeastern corner of the province. Some of the mountains in the southeastern part are moderately folded and faulted sedimentary and volcanic rocks. Cliff forming rocks including formations of limestone, dolomite, quartzite and greenstones are also found

in this area, along with continental sandstones and conglomerate of late Cretaceous and early Tertiary age. Farther west the basins are mantled with outwash gravel, silt and morainal deposits over Pre-cambrian schists and Mesozoic granitic intrusions.

(3) Western Alaska Province - Geology. Folded and faulted Cretaceous sedimentary rocks cover most of this province. Some of the gently rolling hills in the northwest corner are underlain by Palezoic and Mesozoic metamorphosed volcanics and granitic intrusives. Lava flows mantled with river flood plain deposits and wind borne silt cover the lowlands towards the west.

d. Pacific Mountain System

(1) Alaska Aleutian Province, Coastal Trough and Pacific Border Ranges - Physiography. Three provinces make up the Pacific Mountain System. The Taiga Coniferous Forest boundary extends into the Alaska-Aleutian Province and the Coastal Trough Province. The Northwest Coastal Coniferous Forest is spread over the Pacific Border Ranges.

Many parallel rugged glaciated north and northeast trending ridges 7000 - 12,000 feet in altitude, and dotted with large lakes that occupy glaciated valleys make up the southwestern Alaska Ranges. Glaciated peaks varying in height between 6000 - 9000 feet cover the central and eastern portions of the Alaska-Aleutian Province. Braided glacial streams follow the trend of the glaciated valleys and major river drainages.

The Coastal Trough Province is a continuous belt of lowlands with uplifts of oval mountains breaking up the topographic expression. Glacial features, including drumlins, eskers, outwash plains, and moraines, are easily discernible in the lowlands. The mountains also show evidence of glaciation as is expressed by their rugged peaks and U-shaped valleys.

The Pacific Border Range Provinces which are covered by the Northwest Coastal Coniferous Forest includes a rugged barrier of mountains varying in altitude from 3000 feet in the western part to spectacular isolated blocklike mountains rising up to 19,000 feet in elevation. The central Gulf of Alaska has a more diversified topography marked by longitudinal beach and sand dune ridges, crossed by outwash plains and morainal topography.

(2) Aleutian Range - Geology. Granitic batoliths intrude into moderately metamorphosed and highly deformed Paleozoic and Mesozoic volcanic and sedimentary rocks in the southern Alaska Ranges. Structurally the rocks trend in a northerly direction.

The central and eastern Alaska Ranges is a complex synclinorium (a belt of folded inward dipping rocks) having cretaceous rocks in the center and Paleozoic and Pre-cambrian rocks on the flanks.[21] Granitic stocks and batholiths support some of the high mountains.

(3) Coastal Trough - Geology. Glacial moraine and outwash overlies poorly consolidated coal-bearing rocks of Tertiary

age. The isolated mountains within the lowlands generally consist of metamorphic and granitic rocks of Mesozoic Age.

(4) Pacific Border Province - Geology. The higher mountain masses are composed of sedimentary and metamorphic rock, Mesozoic in age, underlain by crystalline schist and granitic intrusives. Volcanic and sedimentary rocks extend along the north side of the St. Elias Mountains. The general trend of the mountain masses is east-west.

D. Minerals[22-24]

The Coniferous Forest Biome of the Western United States and Alaska which include the Northwest Coastal Coniferous Forest and the Montane Coniferous Forest have a diverse accumulation of locatable, leasable and saleable minerals distributed within their boundaries. Although at a first glance it appears these minerals are randomly dispersed, a closer examination of an economic minerals map and geologic maps showing rock types, tectonics, and geo-physical anomalies, indicate there is some continuity in the occurrence of these minerals. Oil, gas, coal and geothermal steam are here included as minerals although they are not classified as such in the strict geologic definition of the term.

1. Montane Coniferous Forest and Northwest Coastal Coniferous Forest (Excluding Alaska)

Locatable mineral deposits are probably more pronounced in these sub-biomes than in any of the others. The deposits are principally of the vein type and closely associated with the Laramide orogeny of the Rocky Mountains, the Sierra Batholith and the Idaho Batholith within the Montane Coniferous Forest and the Pacific Coast disturbances within the Northwest Coastal Coniferous Forest. The deposits are distributed throughout the sub-biomes with the exception of few, if any, being found in Montane Coniferous Forests in east-central Arizona and west-central New Mexico, Wyoming and southeast Montana. lc

Locatable minerals that occur most commonly include gold, silver, copper, lead, zinc, iron, manganese, chromium, cobalt, nickel, molybdenum, vanadium, tungsten, niobium, tantalum, tin, fluorspar, barite, gypsum, magnesite, and brucite.

Leasable minerals are principally evaporite bedded deposits found along the flanks of the mountain ranges, including Potassium ~~potash~~, ~~borates,~~ sulfur and phosphate. Coal of all types, varying from anthracites through bituminous and lignites can be found with the principal concentrations occurring in the Rocky Mountain and western Interior Plains physiographic systems. Few if any leasable mineral deposits are found in these portions of the biome in northeastern Washington, northeastern Oregon, Idaho, northwestern Montana, and central Arizona although further exploration may yield minerals within these areas. Much of the lands have been classified as potentially valuable for geothermal steam and associated geothermal

Sodium, Oil impregnated rocks

phosphate in this area

resources. It is unlikely that the other leasable and locatable mineral deposits will occur in areas of primary importance for oil and gas. (Fig. 6 & 7).

Salable minerals including sand, stone, gravel, pumice, pumicite, cinders, clay, other mineral materials and petrified wood are ubiquitous throughout the biome.

2. Taiga Coniferous Forest and Northwest Coastal Coniferous Forest (Alaska)

Locatable minerals are found throughout the Taiga and Northwest Coastal Coniferous Forest areas (Fig. 8). The prominent minerals included fluorspar, barite, gypsum, zinc, gold, silver, copper, lead, tin, and platinum. The gypsum which is found in the northwest coastal area is of the evaporite type. Most of the minerals are found in close association with the fault systems throughout the area, and are primarily of the fissure filling or vein replacement type. Some of the deposits, in particular tin, gold, silver and platinum are found as placer deposits along rivers. Barite occurs in bedded cretaceous sediments in the northwest coastal area.

The leasable minerals in these same areas include coal, geothermal steam and associated geothermal resources and oil and gas (Fig. 9). The leasable minerals in these areas include coal, oil gas, geothermal resources

E. Soils

The soils in the Coniferous Forest Biome are extremely varied in depth, texture, and stoniness. They occur on topography that ranges from nearly level to very steep and range from poorly

MAP OF THE WESTERN UNITED STATES SHOWING LANDS CLASSIFIED FOR GEOTHERMAL

(Source: USGS Circular 647)

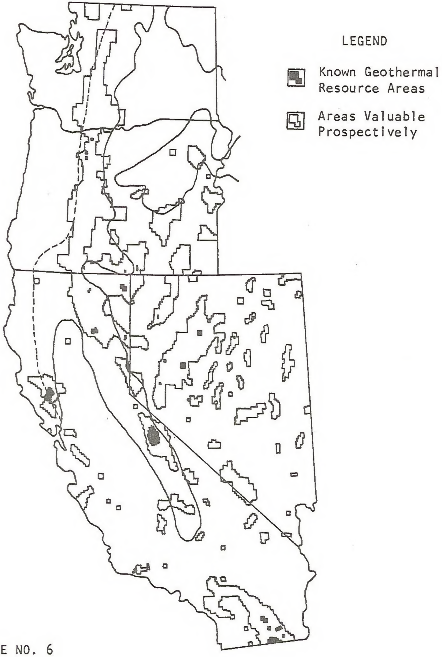

LEGEND
▪ Known Geothermal Resource Areas
☐ Areas Valuable Prospectively

FIGURE NO. 6

MAP OF THE WESTERN UNITED STATES SHOWING LANDS CLASSIFIED FOR GEOTHERMAL

(Source: USGS Circular 647)

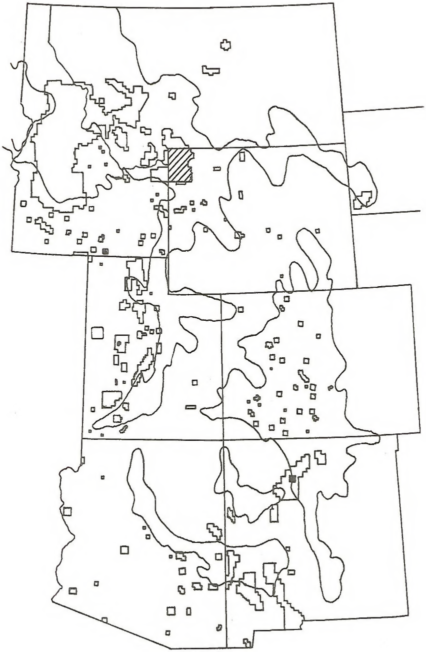
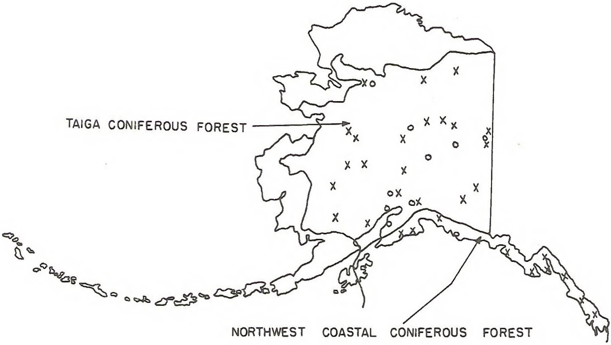


FIGURE NO. 7

CONIFEROUS FOREST BIOME

(Source: 1970 National Atlas)



MINERAL PRODUCING AREAS

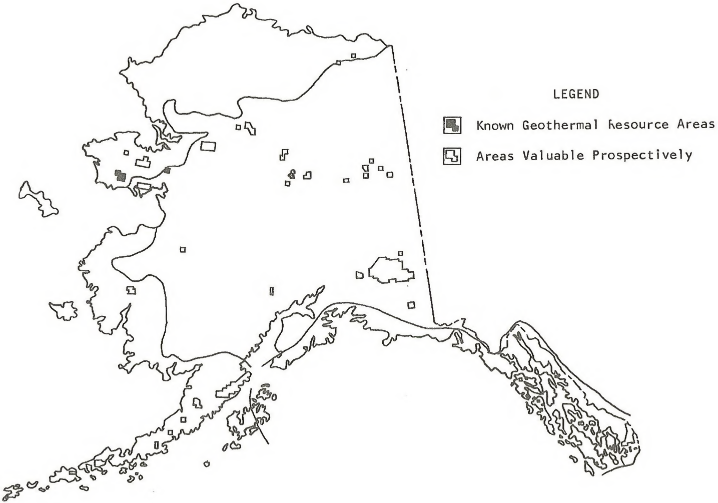
○ Leasable Minerals
× Locatable Minerals (other than gas & oil)

FIGURE NO. 8

FIGURE NO. 9

MAP OF ALASKA SHOWING LANDS CLASSIFIED FOR GEOTHERMAL RESOURCES EFFECTIVE DECEMBER 24, 1970

(Source: USGS Circular 647)


LEGEND
▨ Known Geothermal Resource Areas
☐ Areas Valuable Prospectively

drained to well drained. These soils will be discussed at an order level, which is quite broad, and is based on weathering characteristics. These orders are shown on Figure 10 and are defined as follows:

- Alfisols - Soils that are medium to high in bases and have gray to brown surface horizons and subsurface horizons of clay accumulation, usually moist but during the warm season of the year some are dry part of the time.
- Aridisols - Soils that have pedegenic horizons and are low in organic matter and never moist as long as three consecutive months.
- Entisols - Soils that have no pedogenic horizons.
- Inceptisols - Soils that have weakly differentiated horizons, materials in the soil that have been altered or removed but have not accumulated. These soils are usually moist but during the warm season of the year some are dry part of the time.
- Mollisols - Soils that have nearly black, friable, organic-rich surface horizons high in bases, formed mostly in subhumid and semiarid warm to cold climates.
- Ultisols - Soils that are low in bases and have subsurface horizons of clay accumulation, usually moist, but during the warm season of year some are dry part of the time.

Generally, the Northwest Coastal's major soil orders are Ultisols and Inceptisols; the Taiga's major order is Inceptisols; and the Montane's major orders are Mollisols and Alfisols. In the parts that follow the soil orders that are found throughout the Coniferous

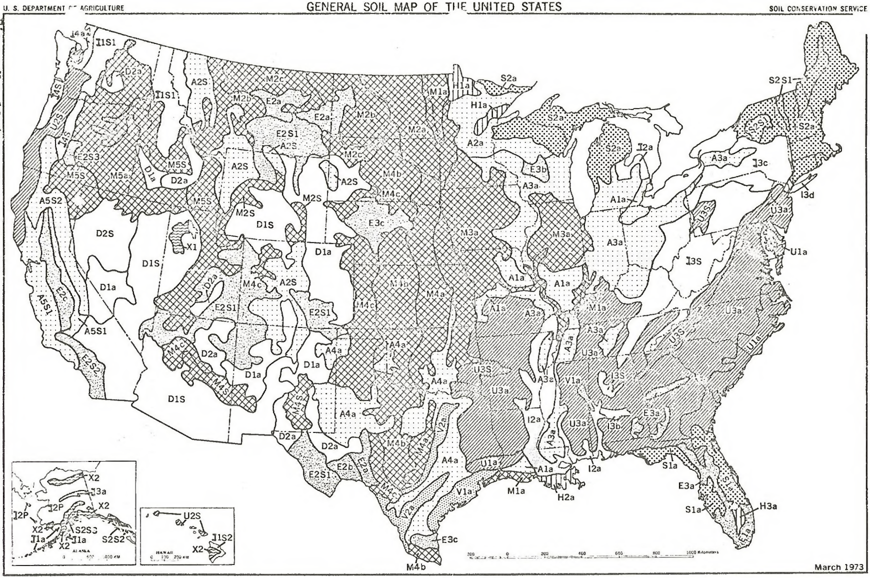


Figure No. 10 (Legend on following page).

Legend

Alfisols - Symbols starting with A

Aridisols - Symbols starting with D

Entisols - Symbols starting with E

Inceptisols - Symbols starting with I

Mollisols - Symbols starting with M

Ultisols - Sumbols starting with U

Areas with little soil - Symbols starting with X

Forest Biome will be discussed first and then, when applicable, the individual sub-biomes.

1. Northwest Coastal, Taiga and Montane Coniferous Forests

Inceptisols and Ultisols generally occur in the higher elevations and areas receiving larger amounts of precipitation. Ultisols have clay enriched subsoils, are acid in nature and may have light or dark colored surfaces. Characteristics of the Inceptisols vary greatly. The soils in these two orders occur in northeastern California, western Oregon and Washington, adjacent to the Canadian border in northern Idaho and northwestern Montana, and south in the Rocky Mountains to central Idaho. Inseptisols are found throughout Alaska where mineral soils occur.

Inceptisols and Ultisols which are less than 20 inches deep and contain over 35% coarse fragments are very difficult to reforest to the desired level of stocking in the desired length of time. Productivity on these soils is low. Landslide hazard is high after disturbance when the shallow stony Inceptisols are derived from sedimentary bedrock and occur on slopes greater than 80 percent. This is especially true when they are influenced by groundwater such as in draws. Ultisols usually reflect relatively stable conditions. However, landslide hazard is high after road construction if these soils are underlain by weathered bedrock.

Productivity and regeneration success of commercial tree species are high on the deep, non-stony Inceptisols and Ultisols. Compaction hazard is high on Ultisols. Productivity is about one-half a site class lower on the dry Ultisols and Inceptisols than it is on the moist ones. Productivity also is lower on the frigid soils than the wet soils.

2. Taiga Coniferous Forest

Permafrost conditions occur discontinuously through portions of the Taiga Forests of interior Alaska. The soils of the river valleys and the lower side slopes of the mountains are covered with a thin to thick blanket of vegetative material that acts as an insulating mat. In most of interior Alaska, this mat provides protection and stabilizes the underlying soils which are a frozen or a permafrost soil. When the vegetative cover is disturbed or removed, the permafrost is exposed and during the moderate temperature short duration summer period, the exposed permafrost melts at exceedingly high rates.

3. Montane Coniferous Forest

Alfisols occur in areas receiving less rainfall than the Inceptisols and Ultisols. Therefore, the base status is higher. Alfisols have a clay enriched subsoil and a grey to brown surface soil. The large areas of Alfisols are located on the east and west side of the Sacramento Valley in California and areas on the east front of the Rocky Mountains in Montana, Wyoming, and Colorado. Alfisols commonly occur in dry zones. These soils usually have a high hazard for compaction. Reforestation is very difficult on Alfisols as is true of Inceptisols and Ultisols when they are less than 20 inches deep, contain over 35% coarse fragments and occur in a xeric zone. Productivity is also low in these situations.

Alfisols are relatively stable unless they are underlain by decomposed or unconsolidated bedrock.

Mollisols have a high base status, have a surface enriched in organic matter and have dark colored surfaces. Mollisols are located in the southern Rocky Mountains in Utah and Arizona. Mollisols occur under dry and moist conditions as well as warm and cold conditions. Productivity decreases as Mollisols become dry and also when they become cold. Mollisols less then 20 inches deep occurring in the dry zone and containing over 35% coarse fragments have severe reforestation problems.

Entisols are young soils lacking diagnostic horizons. They occur in areas having recent deposits of alluvium, on very steep, raveling slopes and on recently stabilized sand dunes. These soils occur in western Colorado, northwestern New Mexico and central Utah. Entisols on steep raveling slopes are unstable and have a high hazard for landslides and erosion. Most Entisols that occur on the floodplains have a high hazard for flooding.

Aridisols are generally associated with the desert as they have prolonged dry periods. However, there are small areas of Aridisols supporting coniferous forests in New Mexico and Arizona, Moisture is a limiting factor on these soils.

F. Water[25-27]

The water resources of the Coniferous Forest Biome provide most of the water needs for the western United States. In the subregions of the Columbia-North Pacific, northern California, Great

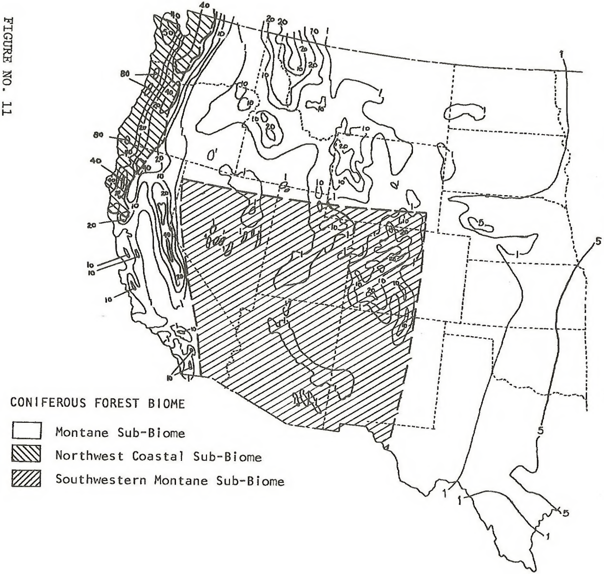
Basin and the Upper and Lower Colorado, over 90% of the runoff originates in high elevation forests. The major rivers and streams which originates in forested regions also contribute to recharge of the ground water aquifers underlying adjacent biomes (grassland, desert, woodland-bushland). The generally higher elevation coniferous forests vary widely in annual precipitation received from as low as 5 inches in the extreme northern part of the Taiga Forest in Alaska to more than 200 inches at some stations along the coastal area of southeastern Alaska and northwestern Washington. Many of the coniferous forests are water surplus areas because of the large amounts of precipitation and these forests provide generous quantities of high quality water which in some areas exceeds the demand.

1. Surface Water

The large quantities of water found in the Coniferous Forest Biome occur as streams, rivers, lakes, reservoirs, springs, marshes, muskeg, and pot holes. These water resources are extremely important for many uses including power generation, industrial, municipal, agricultural, recreation and fish and wildlife. One measure of the improtance of this resource is given by the large number of international, interstate, intrastate, and interagency agreements on the disposition of water for various uses.

Water yield from coniferous forests shows extreme regional variation ranging from about 1 inch per year in the southwester Montane (Fig. 11) to over 200 inches at some locations in the Northwest Coastal on the southeastern Alaska coast. Along the lower elevation

FIGURE NO. 11



AVERAGE ANNUAL RUNOFF

FOR THE

WESTERN UNITED STATES

(Source: Linsley, Kohler, & Paulhus, "Applied Hydrology", Fig. 9-25) coastal areas of the Northwest Coastal in northern California, Oregon and Washington, where much of the precipitation occurs as winter rainfall, most of the runoff comes during the period of November through March. The runoff from mountainous areas adjacent to the Gulf of Alaska shows little seasonal variation since streamflow is derived from both rainfall and snowmelt.

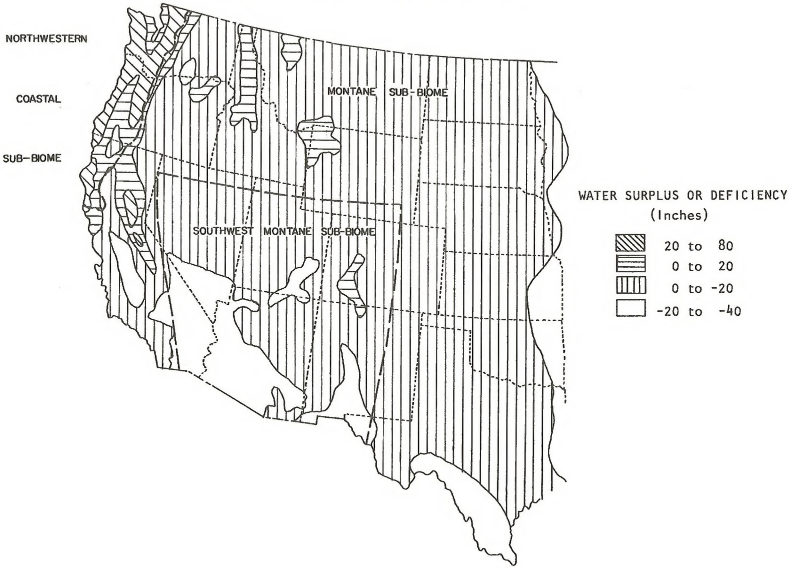
The Taiga in the interior of Alaska has low runoff rates and progressively shorter summer runoff seasons with increasing latitude. In these areas 80% to 95% of the annual runoff occurs during the 5-month period from May to September. In this area permafrost restricts subsurface drainage, creates extensive areas of wetlands and muskeg, and restricts groundwater recharge. As a result, many streams have little or no winter-flow. Severe annual floods, complicated by ice jams, are characteristic throughout this region. Large areas are inundated each year by overbank flow, which requires evacuation of villages along the rivers. Ice scouring contributes to heavy debris and sediment loads during the spring breakup.

Many parts of the northern Montane region produce surpluses of good quality water (see Fig. 12). Most of the runoff appears in response to snowmelt and spring rains. This region has a low runoff period from late summer through late spring. Much of the region has a water deficiency of from 0 to 20 inches, where the demands on water exceed the supply by this amount (Fig. 4).. Streamflow from the southwestern Montane region depends heavily upon snowmelt contributions from the high elevation coniferous forests.

FIGURE NO. 12

AREAS OF NATURAL WATER SURPLUS AND NATURAL WATER DEFICIENCY

(Source: The Nation's Water Resources)



For example, in the upper Colorado River basin 75% of the streamflow originates as snowmelt from 33% of the area of this region which is in coniferous forest or above timberline.

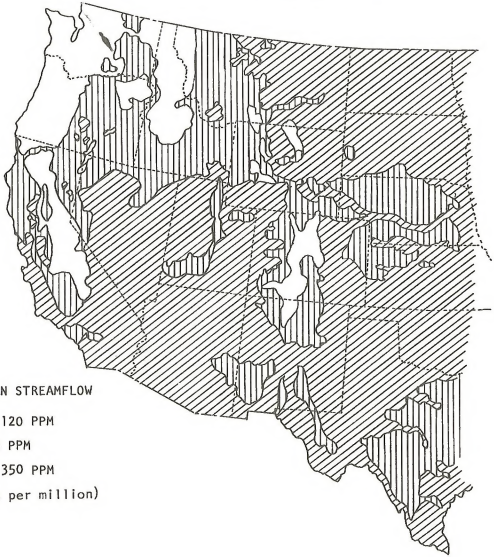
Research is currently underway in forests of the Sierras on augmentation of water supplies by vegetative manipulation in the upper timber zone. Harvesting timber in patterns which encourage greater snow-pack accumulation has resulted in an increased water yield of over 4 inches in operational programs. Forest management for augmentation of runoff is also found in the southwestern Montane forests of the Colorado Rockies.

Water quality is generally good throughout the Taiga except for two specific situations, (1) sediment contribution of glacier-fed streams is high, and (2) waters derived from extensive muskeg and swamp areas are unusually high in organic compounds and iron content because of the restricted subsurface drainage. The quality of most surface waters in the Northwest Coastal in Oregon and Washington is generally good with concentration of dissolved solids less than 120 ppm (Fig. 13). Similar low concentrations may be found in the northern Montane along the Cascades, the Sierras, and in northern Montana. Concentration of dissolved solids is much higher in streamflow from the southwestern Montane. This decrease in water quality is caused by lower annual percipitation, greater evaporation and geologic material which is more easily soluble in water.

FIGURE NO. 13

CONCENTRATION OF DISSOLVED SOLIDS IN STREAMFLOW

(Source: The Nation's Water Resources)



DISSOLVED SOLIDS IN STREAMFLOW

☐ Less than 120 PPM
▥ 120 to 350 PPM
▨ More than 350 PPM

(Measured in parts per million)

Sediment concentration in streamflow is generally low in streamflow in the Taiga, the coastal areas and much of the northern Montane region (Fig. 14). Exceptions are glacial streams in Alaska (as already noted) and around Mt. Rainier in Washington. Streamflow in the southwestern Montane is more likely to have higher sediment concentrations because of the higher incidence of summer thunderstorms and because much of the geologic material is relatively easy to erode. An exception to this is the area around the Colorado Rockies which is composed of relatively hard rock.

Total nitrogen content of streams draining coniferous forest lands averages about 0.5 parts per million. By contrast, a stream draining agricultural lands may contain twice this concentration of nitrogen.

The dissolved oxygen content of water depends upon temperature, turbulence of flow (which entraps atmospheric oxygen) and the amount of organic material in the water which requires oxidation. The capacity of water to hold dissolved oxygen decreases as water temperature increases, as the turbulence of stream flow decreases (because of reduced entrapment of oxygen) and as the amount of organic material in the stream increases.

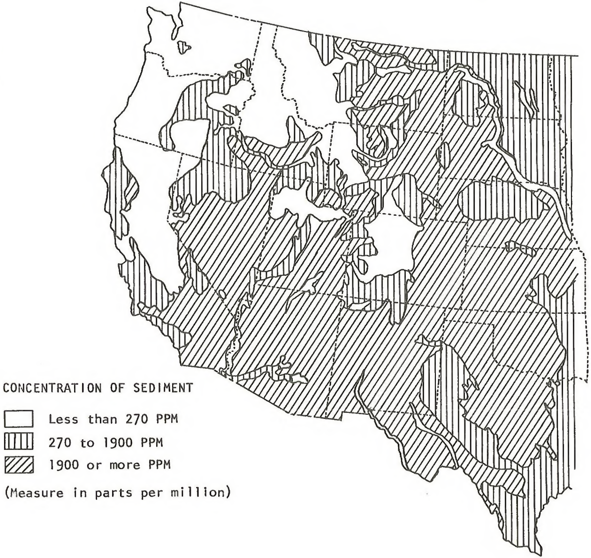
2. Groundwater

Large quantities of groundwater are known to be available throughout most of the Yukon River flood plain in the Taiga region of Alaska. Little use is presently being made of this resource because settlement and industry are almost non-existent. In portions of the

FIGURE NO. 14

CONCENTRATION OF SEDIMENT IN STREAMS

(Source: The Nation's Water Resources)



region which are underlain by permafrost, groundwater is extremely difficult to obtain. High salinity is a problem in the northern part of the Taiga.

Groundwater is limited in the Northwest Coastal region of Alaska where steep mountains, rapid runoff, and a lack of surficial deposits to store and retain groundwater preclude its use. Groundwater aquifers in the Northwest Coastal are composed of alluvial valley fills surrounded by forested mountains from which they receive runoff replenishment. One of the largest of these aquifers is within the Willamette Valley-Puget Sound Trough in Oregon and Washington (Figure 15). The Northwest Coastal also overlaps another alluvial groundwater aquifer in northern California, where runoff from forested watersheds replaces annual groundwater pumpage. Smaller alluvial aquifers within valleys provide a source of groundwater for municipal and industrial use at many locations in the northern Montane region. An important source of replenishment for these aquifers is infiltration of water from streams which arise in the coniferous forests.

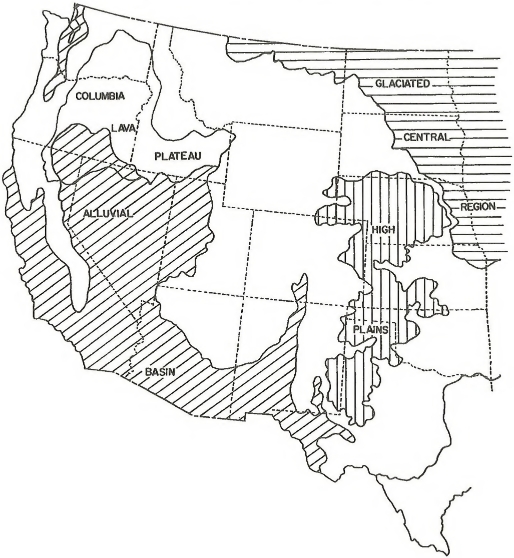
G. Climate and Air

A dense forest, says Zon, is like an enormous umbrella with holes in it, covering the earth.[28] It is to be expected that the elements of climate -- moisture, temperature, light, air movement -- are modified under such a cover. Moreover, the climate adjacent to but not under the umbrella is also somewhat modified. It follows

FIGURE NO. 15

MAJOR AREAS OF POTENTIAL GROUNDWATER DEVELOPMENT

(Source: The Nation's Water Resources)



that, even though man can do little or nothing to affect the climate in general, he can influence it to some extent locally by adding or removing forest cover.[29]

Different kinds of forests have different effects, but numerous observations have shown that, in general, the sub-biomes of the Coniferous Forest Biome have certain local climatic effects in common. Some of these effects are as follows:[29]

- The mean maximum monthly air temperature in the forest is about 4°F. lower during the summer than the temperature outside; in winter, it is about 2° lower.
- Forest soil is warmer by 2° in winter and 5° to 9° cooler in summer than soil outside the forest, and freezing, if any, is significantly less deep than outside.
- Sunlight intensity is reduced 50 to 90 percent within the forest, the amount of reduction depending on the density of the forest cover and its species composition (kinds of trees constituting the forest).
- A considerable amount of total precipitation is intercepted by the forest crown and evaporates before it can reach the ground.
- The relative humidity of the air is greater within the forest than outside by 3 to 12 percent. Evaporation from the soil under the forest is reduced, the magnitude being dependent upon the forest canopy.
- Air temperature differentials between forests and adjoining open areas cause air movement between forests and fields. These air

currents facilitate the formation of dew and fog over adjoining fields.

- Wind velocities are immensely reduced within the forest.

Forests affect climate but climate affects forests to a far greater extent. Climate and soils are the two major factors which have determined the location and character of the great forest zones of the world.[30]

The geographical occurrence of the Coniferous Forest Biome, and its species composition, are influenced to a large extent by moist air masses moving easterly from the mild temperatures of the Pacific Ocean's Japan Current;[31] by polar air masses originating over the Arctic Ocean, interior Alaska and northwestern Canada; and by extensive mountain ranges that modify marine air from the Pacific, act as barriers to incursions of polar or tropical air, and support, on their slopes, climatic conditions which vary with changes in elevation, latitude, soil, exposure and land form.

Significant climatic differences within the biome require separate discussion, as follows.

1. Northwest Coastal Coniferous Forest

This sub-biome is characterized by heavy rainfall during late autumn, winter and spring. Moist winds from the Pacific Ocean have given rise to the forests of this region.[32] July and August are generally the driest months; December and January the wettest[33] (see Figures 17, 18, and 19). Average annual precipitation ranges from 20-25 inches in the San Francisco area[34] and 60-140 inches on the

Olympic Peninsula of Washington, to 60-160 inches on the southern and southeastern coast of Alaska[35] (Figure 16). More than two-thirds of this annual precipitation falls during the period from October 1 to March 31.

Low temperatures range from -25°F. on the southern coast of Alaska to 25° at Oakland, California;[36] high temperatures can exceed 90° throughout the sub-biome[37]. Mean monthly temperatures range from 25° (Alaska coast) and 45° (California coast) in midwinter, to 55° (Alaska coast) and 65° (California coast) during July.[38] The length of growing season (period between last killing frost in spring and first killing frost in fall) ranges from more than 300 days in the southern latitudes of the sub-biome to as little as 100 days along the Alaska coast.[39]

During the winter months, coastal southwesterly winds sometimes attain hurricane force, causing extensive damage to forest stands. Northerly winds prevail in summer. Thunderstorms are infrequent.

2. Montane Coniferous Forest

In this sub-biome the elevation and latitude are major climatic influences; the higher and more northerly the location, the colder and wetter the climate. There is also a general decrease in precipitation from west to east, which is related to increasing distance from the Pacific Ocean. The oceanic influence is fairly strong on the east slopes of the Cascade Mountains in Washington and Oregon, and in the Sierras of California. The Rocky Mountain area in general has a continental climate. However, the northern part of the intermountain area (that portion of the sub-biome which lies within the Columbia River basin) is rather strongly affected by the Pacific air masses which penetrate the Cascades via the Columbia River gap and move eastward and northeastward across the intermountain plateau to the western slopes of the northern Rockies.

Annual precipitation at the lower forested elevations (3000-4000 feet) generally averages about 16 inches a year. At the higher elevations, approximate annual average precipitation in the Sierras of California is 50 inches, in the Cascades of Washington and Oregon 90 inches and in the Rockies 30 inches (Figure 16). Average January precipitation varies from 8 inches along the Sierras and Cascades to 1-3 inches in the Rockies. July precipitation averages 1 inch or less in the Sierras and Cascades and 2-3 inches in the Rockies (Figure 17 and 18).

Nearly all winter precipitation at the higher elevations occurs as snowfall. Snow depths are periodically measured at fixed locations, as basis for predictions of spring and summer streamflow at lower elevations.

Average temperatures during January range from about 30° at the lower elevations and southern latitudes to 10° at the higher elevations and northern extremes of the sub-biome. Mean July temperatures vary from 60° to 75°.[26] Maximum length of growing seasons is about 200 days (lower elevations, southern latitudes), minimum length about 60 days.[26]

FIGURE NO. 16

AVERAGE ANNUAL PRECIPITATION

(Source: The National Atlas of the U.S.A.)

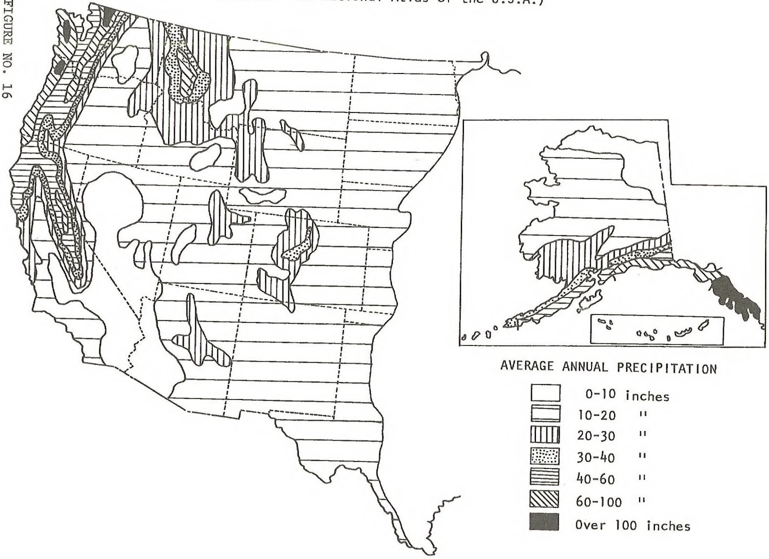


FIGURE NO. 17

MONTHLY PRECIPITATION (INCHES) - JULY

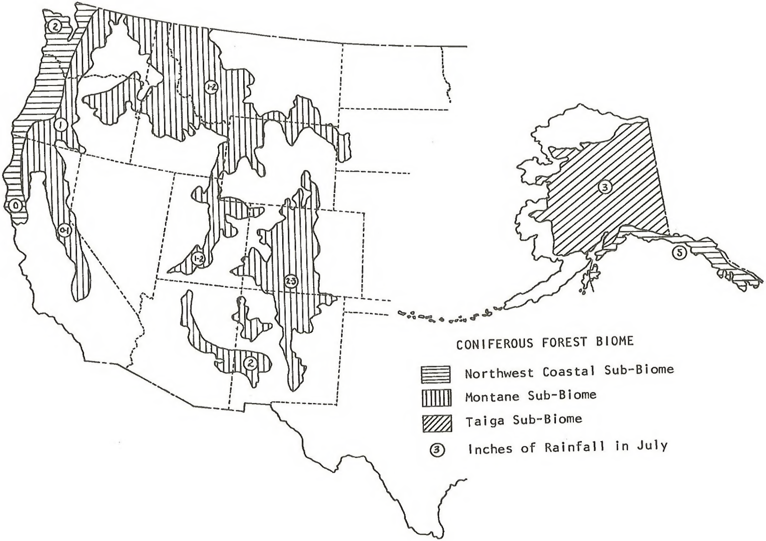
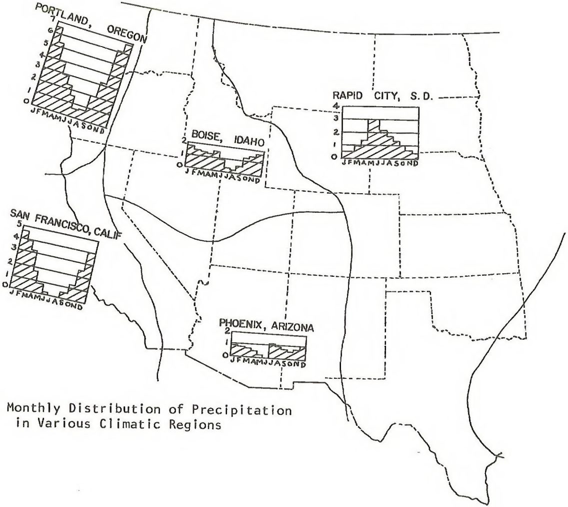


FIGURE NO. 18

MONTHLY PRECIPITATION

(Source: Linsley, Kohler, & Paulhus, "Applied Hydrology", Fig. 6-22)



Typical Monthly Distribution of Precipitation in Various Climatic Regions

Wind directions and velocities are influenced by topography. There is considerable convective activity, expecially during the summer months. At the summits of the mountain ranges, winds are generally from the west and are frequently very strong in winter and spring.

Thunderstorms are frequent in the northern Rocky Mountain and intermountain plateau areas (40-50 thunderstorms annually), and in the central and southern Rockies (50-70 annually). Usually occuring during the warm, dry months of summer, these storms are accompanied by lightning activity which frequently causes fires in inaccessible forested areas, thus creating major protection problems.

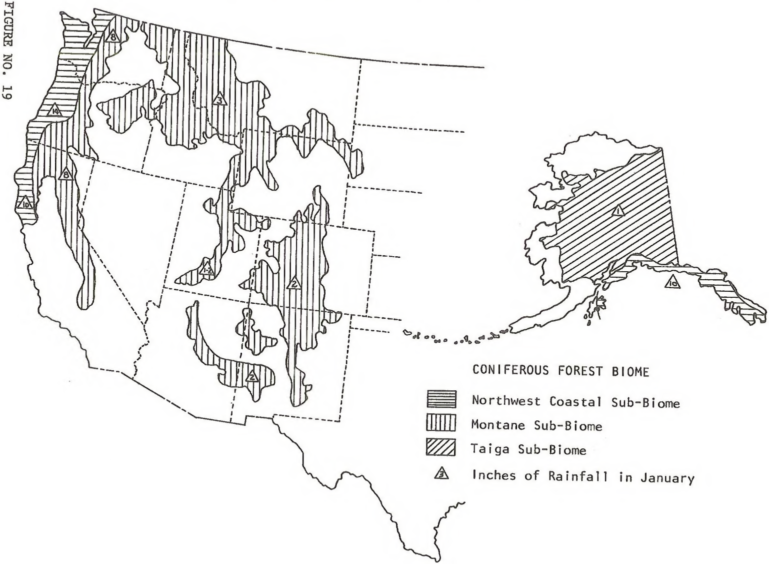
3. Taiga Coniferous Forest

This sub-biome is characterized by severe winters. Average annual precipitation varies from 7 inches in the upper Yukon Valley (at Fort Yukon) to 12 inches at Fairbanks and 16 inches in the Matanuska Valley, although some of the higher elevations receive more than 30 inches (Figure 16). July and August are the wettest months, January one of the driest[40] (Figure 19).

Low temperatures range from -35° in the Matanuska Valley to -78° in the Yukon basin (at Fort Yukon). High temperatures of 91° in the Matanuska Valley and 100° at Fort Yukon have been recorded. Mean monthly temperatures vary from a low of -22° in January (at Fort Yukon) to 60° in July (at Fairbanks). Growing season lengths range from about 63 days (minimum) at McKinley Park to as much as 93 days at Bethel.[41]

FIGURE NO. 19

MONTHLY PRECIPITATION (INCHES)-JANUARY



The possible daily hours of growing season sunshine vary with latitude. In June, the lower latitudes can receive 16 hours of sunshine per day, northern portions of the sub-biome 24 hours. However, cloud cover limits the amount of solar radiation actually received. Even in interior Alaska there are nearly as many cloudy days as clear ones during the growing season.[42]

Over much of the Taiga, severe climate and organic (peat) soils have combined to create a condition of permanently frozen ground (permafrost). This is the tundra, where the mean temperature of the warmest month is below 50° F., and only the top layer of soil thaws during the warm season.[43] The southern limit of continuous permafrost lies just south of the Brooks Range, the timber line of which marks the northern boundary of the Taiga Coniferous Forest. South of the continuous permafrost area, discontinuous permafrost occurs over most of the Taiga to its southern limit.[44]

H. Vegetation

1. Terrestrial Vegetation

Coniferous trees are the predominant form of vegetation, covering extensive areas, ranging from the Pacific Coast, including Alaska, to the eastern foothills of the Rocky Mountains. Within the Coniferous Forest Biome, the identifying life-form is the needle-leafed evergreen tree, especially the spruces, firs, pines, Douglas-fir, hemlocks and "cedars", one or more of which are predominant in forest stands. This description therefore concentrates heavily upon the forest; associated plant communities such as alpine meadows are only briefly mentioned or omitted entirely.

For the purpose of describing vegetation, the Montane Sub-Biome has been subdivided into two regions. Each region in turn is stratified into vegetational "zones" as influenced primarily by elevation. The Northwest Coastal Sub-Biome is divided directly into vegetational zones, omitting the regional breakdown. Two general type of forests are generally recognized in Taiga.

Within each vegetational zone, numerous plant communities exist, some of which may be identifiable on the basis of species (trees, shrubs and herbs) present and their abundance. Since these plant communities develop in relation to the sum of environmental factors acting on the specific forest area, they may therefore be used (given adequate knowledge) to indicate the presence of such factors. Historically, fires have played a significant role in influencing and maintaining certain species and associations.

Throughout the Biome, the ease by which new forests can be regenerated may be predicted by determining whether environmental factors combine to produce a relatively "cool and moist" site or a relatively "warm and dry" one. Accordingly, this section identifies plant species generally adapted to these two categories for zones where information is readily available.

a. Taiga Coniferous Forest

In general, the Taiga can be characterized as a number of vast virgin forests located along major river drainages consisting of overmature stands of white spruce and related species.

Vegetation in interior Alaska[44] forms a mosaic of patterns that is related in part to past fire history, to slope and aspect, and to the presence or absence of permafrost. Two general forest classifications are recognized:

(1) White Spruce Forest. Spruce-hardwood forests with closed canopies are typical of "warm" dry uplands (east, south and west exposures) and well drained flood plains along the glacial rivers. This forest is characterized by the usual successional process of (1) fire, to (2) hardwoods such as willow (Salix), quaking aspen (Populus tremuloides), paper birch (Betula papyrifera) and balsam poplar (Populus balsamifera) to (3) white spruce (Picea glauca). Other hardwoods and shrubs common at some point during the successional period include alder (Alnus), bearberry (Arctostaphylas uva-vrsi), red-fruit bearberyy (A. rubra), Labrador tea (Ledum groenlandicum), narrowleaf Labrador tea (L. decumbens), American red currant (ribes triste) prickly rose (Rosa ocicularis) willow (Salix), buffalowberry (Shepherdia canadensis), mountain cranberry (Vaccinium vitis-idaea), bog blueberry (V. uliginosum), high bushcranberry (Viburnum edule), and dwarf blueberry (Vaccinium caespitosum). The forest floor is usually carpeted with a thick moss mat.

(2) Black Spruce Forest. "Open, low growing spruce forests" are typical of north facing slopes and poorly drained lowlands, usually underlain by permafrost. This forest generally lacks the successional characteristic of the previously described forest

since the major forest tree, black spruce (Picea mariana) is a pioneer species. Tamarack (Larix laricina) and white spruce (Picea glauca) are associated needle-leafed trees. Common hardwoods and shrubs include paper birch (Betula papyrifera), red-fruit bearberry (Arctastaphylos ura-ursi), crowberry (Empetrum nigrum), Labrador tea (Ledum groenlandieum), prickly rose (Rosa acicularis), willow (Salix), bog blueberry (Vaccinium uliginosum), and mountain cranberry (V. vistis-idaea). Subordinate vegetation consists of a thick moss mat, sedges, grasses and the above shrubs.

b. Northwest Coastal Forest

The Bureau administered lands in this sub-biome can be generally characterized as a predominantly Douglas-fir forest, approximately a third of which is comprised of old growth stands 200 years in age and older. These lands are intermingled with private lands that generally support a young growth forest and in total are relatively well developed due to past and current timber harvesting activities.

It is the most densely forested region in the coniferous biome and generally regenerates, easily and quickly, grows rapidly and reaches impressive sizes. Mature forests usually have lush understory, shrub and herbaceous layers comprised of shade tolerant conifers, shrubs, ferns, other herbs, mosses and liverworts.

Plant succession in the Northwest Coastal sub-biome following removal of forest vegetation usually proceeds through three stages, (1) rapid growth of residual and invading herbaceous plants (such as grasses and ferns), (2) gradual development into a shrub dominated condition and (3) development of the young growth forest. Stages one or two, or both may not occur depending upon environmental factors. Either of the first two stages may also dominate for exceedingly long periods of time, also due to environmental factors. There is an expecially strong tendency to develop dense shrub and hardwood communities of moisture loving species (such as alder, salmonberry and huckelberry) where moisture is abundant.

Franklin and Dyrness have identified five major coniferous dominated vegetation zones within the sub-biome; they include (1) the coastal "Sitka Spruce Zone", (2) the widespread inland low to mid-elevational "Western Hemlock Zone", (3) the higher elevational "Pacific Silver Fir Zone", (4) the sub-alpine "Mountain Hemlock Zone", and (5) "Timberline".[45]

Major tree species found within the Northwest Coastal Sub-Biome and their occurrence within the major zones are shown on Table I and are estimated as follows: 1 = abundant, 2 = common, 3 = uncommon, 4 = rare or absent.

TABLE I

NORTHWEST COASTAL SUB-BIOME

SPECIES OCCURRENCE BY ZONES

	*	*	ZONES		
Species	Sitka Spruce	Western Hemlock	Pacific Silver Fir	Mountain Hemlock	Timber-line
Western White Pine (Pinus monticola)	4	3	2	3	4
Sugar Pine (Pinus lambertiana)	4	3	3	3	4
Whitebark Pine (Pinus albicaulis)	4	4	4	2	1
Lodgepole Pine (Pinus contorta)	1	4	2	3	3
Ponderosa Pine (Pinus ponderosa)	4	3	4	4	4
Western Larch (Larix occidentalis)	4	4	3	3	4
Engelmann Spruce (Picea engelmannii)	4	4	2	2	2
Sitka Spruce (Picea sitchensis)	2	3	4	4	4
Western Hemlock (Tsuga heterophylla)	1	1	2	3	4
Mountain Hemlock (Tsuga mertensiana)	4	4	2	2	2
Douglas-fir (Pseudotsuga menziesii)	1	1	2	3	4
Grand Fir (Abies grandis)	2	2	3	4	4
Pacific Silver Fir (Abies amabilis)	4	3	1	2	3
White Fir (Abies concolor)	4	4	4	4	4
Noble Fir (Abies procera)	4	3	2	3	4
Shasta Red Fir (Abies magnifica)	4	4	3	3	3
Subalpine Fir (Abies lasiocarpa)	4	4	2	2	2
Redwood (Sequoia sempervirens)	2	4	4	4	4
Incense-Cedar (Libocedrus decurrens)	3	2	3	4	4
Western Redcedar (Thuja plicata)	2	2	3	4	4

*zones containing significant amounts of BLM acreage.

Throughout the Sitka Spruce and Western Hemlock zones (both more commonly known together as the Coastal Douglas-fir region) which are the predominant zones, relatively "cool-moist" and "warm-dry" sites may be indicated by the presence (usually in abundance) of the following species in forest stands:

TABLE II

Species (X=Presence)	SITE Cool-Moist	 Warm-Dry
TREES (C = Canopy only, R = Reproducing under canopy)		
Douglas-fir (Psudotsuga menziesii)	X(C)	X(R)
Incense Cedar (Libocedrus decurrens)		X
Ponderosa Pine (Pinus ponderosa)		X
Sitka Spruce (Picca sitchensis)	X	
Western Hemlock (Tsuga heterophylla)	X	
Western Redcedar (Thuja plicata)	X	
BROADLEAF TREES OR SHRUBS		
Red Alder (Alnus rubra)	X	
Pacific Madrone (Arbutus menziesii)		X
Golden Chinkapin (Castanopsis chrysophylla)		X
Oregon White Oak (Quercus garryana)		X
Ocean spray (Holodiscus discolor)		X
Salal (Gaultheria shallon)		X
California hazel (Corylus cornuta calif.)		X
Rhododendron (Rhododendron macrophyllum)		X

Poison Oak (Rhus diversiloba)		X
Rose (Rosa)		X
Creeping snowberry (Symphoricarpos mollis)		X
Devils Club (Oplopznox horridum)	X	
Salmonberry (Rubus spectabilis)	X	
Oregon Myrtle (Umbellularia California)	X	
HERBS		
Swordfern (Polystichum munitum)	X	
Deerfern (Struthiopteris spicant)	X	
Ladyfern (Athyrium filix-femina)	X	
Brackenfern (Pteridium aquilinum)		X
White Inside-Out Flower (Vancouveria hexandra)	X	
Three Leaved Coolwort (Tiarella trifoliata)	X	
Sweetscented Bedstraw (Galium triflorum)	X	
Oregon Oxalis (Oxalis oregana)	X	
Whipple Vine (Whipplea modesta)		X

Port Orford cedar (Chamaecyparis lawsoniana) is a natural component of timber stands on sites of almost any moisture regime in extreme southwestern Oregon. It is currently endangered by a killing root disease (Phytophera lateralis) however, to the extent that it has nearly been eliminated from moist sites and could possibly be eliminated from most of its natural range.

c. Montane Coniferous Forest

Generally, the Bureau administered forests in the Montane are comprised of overmature stands located on scattered lands that have undergone moderate development due to timber harvesting, mining and other activities.

The sub-biome is scattered over extensive areas in the mountainous regions of the contiguous western states and differs from the adjacent Northwest Coastal Forest in that it generally reproduces with difficulty or grows slowly and has a relatively open canopy tending to have sparce understory, shrub and herbaceous layers (exceptions are commonplace). Plant succession in this sub-biome usually follows the three stages outlined for the Northwest Coastal Forest (herbs to shrubs to trees). To facilitate the vegetative description, the Montane Sub-Biome is divided into two regions, (1) "Southwestern Oregon - Northwestern California - Sierra Nevada", and (2) "Eastern Oregon - Eastern Washington - Rocky Mountains".

(1) Southwestern Oregon - Northwestern California - Sierra Nevada. This region may be viewed as having six major elevational forest zones.[46-48] These are: (1) the Sierra's "Ponderosa Pine Zone", (2) the "Mixed Conifer and Mixed Evergreen Zone", (3) the "White Fir Zone", (4) the "Red Fir Zone", (5) the "Mountain Hemlock Zone", and (6) "Timberline". With one major exception, these zones are generally in elevational sequence where elevational differences are sufficient to include them. The exception is in southwestern Oregon and northwestern California where the Ponderosa Pine Zone is absent.

Major tree species found within this region and their occurrence within the major zones are estimated as shown on Table III and are as follows: 1=abundant, 2=common, 3=uncommon, 4=rare or absent.

TABLE III

MONTANE SUB-BIOME

SPECIES OCCURRENCE BY ZONE

S.W. Oregon - N.W. Calif. - Sierra Nevada Region

	*	*	*	ZONES		
Species	Pond. Pine	Mixed C. or E.	White Fir	Red Fir	Mount. Hem.	Timber-line
Western White Pine (Pinus monticola)	4	3	3	3	3	4
Sugar Pine (Pinus lambertiana)	2	2	3	3	3	4
Whitebark Pine (Pinus albicaulis)	4	4	4	3	2	1
Lodgepole Pine (Pinus contorta)	2	3	3	3	2	2
Ponderosa Pine (Pinus ponderosa)		1	2	3	4	4
Jeffrey Pine (Pinus jeffreyi)	2	3	3	4	4	4
Engelmann Spruce (Picea engelmannii)	4	4	4	3	3	3
Western Hemlock (Tsuga heterophylla)	4	3	4	4	4	4
Mountain Hemlock (Tsuga Mertensiana)	4	4	4	3	1	2
Douglas-fir (Pseudotsuga menziesii)	2	2	2	4	4	4
Grand Fir (Abies grandis)	3	3	4	4	4	4
Pacific Silver Fir (Abies amabilis)	4	4	3	2	4	4
White Fir (Abies concolor)	2	2	1	3	4	4
Noble Fir (Abies procera)	4	4	4	3	4	4
Shasta Red Fir (Abies magnifica)		4	4	3	1	2
Subalpine Fir (Abies lasiocarpa)		4	4	4	3	2
Incense-Cedar (Libocedrus decurrens)	2	2	2	3	4	4
Western Redcedar (Thuja plicata)		4	3	3	4	4

* zones containing significant amounts of BLM acreage.

Within the "Mixed Conifer - Mixed Evergreen" and possibly within the White Fir Zones, which are the predominant zones, relatively "cool-moist" and "warm-dry" sites may be indicated by the following plants (usually in abundance) in forests stands:[49,50]

TABLE IV

Species (X = Presence)	SITE	
	Cool-Moist	Warm-Dry
TREES		
Shasta Red Fir (Abies magnifica)	X	
Incense-Cedar (Libocedrus decurrens)		X
Western Hemlock (Tsuga heterophylla)	X	
Western Redcedar (Thuja plicata)	X	
Tanoak (Lithocarpus densiflorus)		X
Pacific Madrone (Arbutus menziesii)	X	
Golden Chinkapin (Castanopsis chrysophylla)		X
Canyon Live Oak (Quercus chrysolepis)		X
Oregon White Oak (Quercus garryana)	X	
Calif. Black Oak (Quercus kelloggii)		X
SHRUBS & HERBS		
Poison Oak (Rhus diversiloba)		X
Rose (Rosa)		X
Trailing Blackberry (Rubus ursinus)	X	
Vine Maple (Acer circinatum)	X	
Pacific Dogwood (Cornus nuttallii)	X	

California Hazel (Corylus cornuta calif.)	X	
Squaw Carpet (Ceonothus prostratus)	X	
Oregon Grape (Berberis nervosa)		X
Hairy Honeysuckle (Lonicera hispidula)		X
Western White Anemone (Anemone deltoidea)	X	
Hoary manzanita (Arctostaphylos canescens)	X	
Heart-leaved arnica (Arnica cordifolia)	X	
White-veined wintergreen (Pyrola picta)	X	

A notable successional characteristic in the "Mixed Conifer - Mixed Evergreen" and "White Fir" zones in the extensive acreage dominated by brushfields of dry-site species (such as manzanita and ceonothus) that have followed repeated fires to the exclusion of conifer reproduction.[51]

(2) Eastern Oregon - Eastern Washington - Rocky Mountain. This region may also be viewed in terms of elevational zones.[52-54] Four zones are generally found throughout the region. These include: (1) the (usually) lowermost "Ponderosa Pine Zone"; (2) the mid-elevational Douglas-fir Zone; (3) the higher elevational "Englemann Spruce and/or Subalpine Fir Zone"; and (4) Timberline. Other zones are also present on a more localized basis such as (1) "Grand Fir" in eastern Oregon, eastern Washington and northern Idaho; (2) "Western Hemlock" in the same area; and (3) "Lodgepole Pine" in south-central Oregon. Daubenmire[55] recognizes additional communities as related to tree species demonstrating reproductive success; these are "Western Redcedar" and "Mountain Hemlock". Thus throughout this region

an important distinction is that zones do not always occur in a single mountain, nor do they always occur in sequential belts.

Major tree species found within the region and their occurrence within the major zones are shown on Table V and are estimated as follows: 1 = abundant, 2 = common, 3 = uncommon, 4 = rare or absent.

TABLE V

MONTANE SUB-BIOME

SPECIES OCCURRENCE BY ZONE

E. Oregon - E. Washington - Rocky Mountain Region

	ZONES					
Species	* Pond. Pine	* Doug. Fir	Grand* White Fir	* West. Hem.	* Eng.Sp. Sub.Fir.	Timber-line
Western White Pine (Pinus monticola)	4n	4n	3n	1n	3n	4n
Whitebark Pine (Pinus albicaulis)	4n	4n	4n	4n	2n	1n
Lodgepole Pine (Pinus contorta)	2	2	2	2	2	3
Ponderosa Pine (Pinus ponderosa)	1	2	2	4	4	4
Western Larch (Larix occidentalis)	4n	2n	2n	4n	3n	3n
Engelmann Spruce (Picea engelmanii)	4	4	4	3	1	2
Blue Spruce (Picea pungens)	4	3	4	4	2	2
Western Hemlock (Tsuga heterophylla)	4	3	4	1	4	4
Mountain Hemlock (Tsuga mertensiana)	4	4	4	4	2	2
Douglas-fir (Pseudotsuga menziesii)	2	1	2	2	4	4
Grand Fir (Abies grandis)	3n	2n	1n	3n	4n	4n
White Fir (Abies concolor)	3s	2s	1s	3s	4s	4s
Subalpine Fir (Abies lasiocarpa)	4	4	4	4	2	2
Western Redcedar (Thuja plicata)	4	3	3	2	4	4

*Zones containing significant amounts of BLM acreage.

n = northern portion of region only

s = southern portion of region only

In the "Ponderosa Pine Zone", the importance of fire in shaping the vegetation is heavily stressed.[56] Generally speaking, older ponderosa pines are more fire resistant than associated trees, hence this species has dominated in the past. Burning also may substantially reduce shrub cover and favor increased grass cover, especially on dryer sites.

Relatively "cool-moist" and "warm-dry" sites can also be identified by plant communities throughout the Ponderosa Pine Zone in Oregon, Washington, and northern Idaho.[57, 58] Species usually found in forest stands on these sites include:

TABLE VI

Species (X = Presence)	SITE	
	Cool-Moist	Warm-Dry
TREES		
Douglas-fir (Pseudotsuga menziesii)	X	
Grand Fir (Abies grandis)	X	
Western Juniper (Juniperus occidentalis)		X
Oaks (Quercus)		X
SHRUBS & HERBS		
Common snowberry (Symphoricarpus albus)	X	
Mallow ninebark (Physocarpus malvaceus)	X	
Idaho fescue (Festuca idahoensis)		X
Bluebunch wheatgrass (Agropyron spicatum)		X
Needle & Thread (Stipa comata)		X
Bitterbrush (Purshia tridentata)		X

Blue wildrye (Elymus glaucus)		X
Elk sedge (Carex geyeri)	X	
Mountain mahogany (Cercocarpus)	X	
Wheeler bluegrass (Poa nervosa)	X	
Strawberry (Fragaria)	X	
Fireweed (Epilobium angustifolium)	X	
Hawkweed (Hieracium)		X

2. Aquatic Vegetation

Aquatic plants are a vital component of all aquatic ecosystems, and since they are relatively common to all three sub-biomes, will be described on the basis of the Coniferous Forest Biome.

Aquatic plants provide food and cover for insects, fish and other invertebrates as well as waterfowl, fur bearers, certain big game species during some seasons, and non-game birds and animals. A healthy growth of aquatic vegetation along stream banks and lake shores prevents soil erosion, gives additional protection to stream channels during extreme floods, and adds to the natural beauty of the biome. Some type of vegetation grows in nearly all waters of the biome, depending upon water depth and movement, available nutrients, suitable temperature, salinity, light for photosynthesis, and time for growth to take place.

The aquatic environment is often classified as either running or standing water habitat. The running water habitat includes watersheds from the smallest mountain stream at high elevations to major rivers in valleys at relatively low elevations. Running water thus passes through the Coniferous Forest Biome and eventually enters the oceans. Streams at higher elevations generally contain less aquatic vegetation than those at lower elevations due to cooler water, steeper gradients, and a lower concentration of nutrients.

Standing water habitats of lakes, reservoirs, ponds, marshes, and bogs are all found in the biome. A greater variety and more profuse growth of aquatic plants usually occurs in standing rather than in running water habitats. Marshes and ponds are shallow - water habitats. Lakes are generally classified into three major groups according to their geologic age: young, mature and old, having the following characteristics of productivity and aquatic vegetation.[59]

- Young. Geologically young, less productive lakes, deep with narrow shoals or none, clear water of blue to green color, low in nitrogen and phosphorous, low in phytoplankton (both macroscopic and microscopic plants, including algae), and few littoral plants (macrophytes or higher, vascular plants).
- Mature. Geologically more mature and productive lakes, usually shallow with broad shoals, color green to yellow and brownish green with low transparency, rich in nitrogen and phosphorous, rich in phytoplankton with dense blooms, and littoral plants abundant.
- Old. Lakes in bog surroundings or in geologically old land areas, acidic waters yellow to brown with low transparency, low in nitrogen and phosphorous, phytoplankton low with rare blooms, few littoral plants, but rich in humic materials.

Most young lakes are found at higher elevations throughout the Coniferous Forest Biome, whereas mature lakes occur at all elevations. Mature lakes, ponds and marshes (both marine, and freshwater, including estuaries) are areas of enormous biological productivity because of the rich waters and abundant communities of aquatic vegetation.

Aquatic plants are usually grouped into three general categories: free-floating, submersed, and emersed. Representative plant species of each group common to all parts of the Coniferous Forest Biome are listed as follows:[60-63]

- Free-floating. Green and blue-green algae; duckweed (Lemna).
- Submersed. Stonewort or muskgrass (Chara); bladderwort (Utricularia); pondweed (Potamogeton) sometimes immersed; water milfoil (Myriophyllum); and mare's tail (Hippuris).

  Emersed. Floating pondweed (Potamogeton); water shield (Brasenia); pond lily (Nuphar); cat-tail (Typha); bulrush (Scirpus); bur-reed (Sparganium); buttercup (Ranunculus); sedge (Carex); marsh yellow cress (Rorippa); horsetail (Equisetum); spike-rush (Eleocharis); mannagrass (Glyceria); slough grass (Beckmannia); reed canary-grass (Phalaris); cotton-grass (Eriophorum); peat moss (Sphagnum); arrow-grass (Triglochin); and willow (Salix).

Aquatic plants tend to grow in communities depending on water depth, which appears to be the major habitat requirement on most species. In aquatic ecosystems some plants occur in open water, others occupy the littoral zone, (shallow area occupied by vascular plants) and different species grow along the shores of lakes and banks of rivers.

Plant communities are readily apparent in a typical standing water environment. Algae occurs in deep, open water. Duckweed is also found floating in deep water but occurs at all water depths. Rooted vegetation is restricted to the littoral zone where light penetrates. Here dense beds of submersed plants (water milfoil, pondweeds, muskgrass) occur. As water depth decreases in inshore areas, submersed species give way to emersed plants like floating pondweed, pond lily, cat-tail, and bulrush. Vegetation dominating the shallowest water and shoreline includes mannagrass, buttercup, water cress, bur-reed, sedge, and willow.

Plant communities in standing water environments are constantly changing due to natural processes and eutrophication (natural enrichment). Shoal areas are first developed by sedimentation from shore erosion and tributary streams. Rooted vegetation grows on the shoals and contributes to filling of lakes by retaining debris and sediment. Tributary streams continue to add more nutrients. Dense growth of emergent plants and mats of sphagnum moss extend outward from shore. Dead plant material accumulates and further fills the lake. Succession of grasses and sedges then converts the lake into marshes or bogs, and finally dry land. Plant succession is therefore an important factor in the gradual conversion of water bodies to land.

Some aquatic species are adaptable to wide variations in environment. The same species are often found in widely diverse situations of water temperatures, quality, and velocity.[64] They can often survive adverse growing conditions. Examples of cosmopolitan species found throughout parts of the Coniferous Forest Biome were previously listed by genera. Other species are restricted in distribution to more specific conditions; e.g., eel grass (Zostera marina) is an important marine species found along rocky ocean shores and in estuaries bordering the Northwest Coastal Forest. The distribution of many other species is dependent upon altitude and associated climatic differences. The coastal stellate sedge (Carex phyllomanica) grows in coastal marshes of the Northwest Coastal Forest, whereas the Carter Lake sedge (C. campylocarpa) occurs in alpine and subalpine aquatic habitats of Oregon and Washington.

I. Animals

1. Wildlife-Terrestrial[65-74]

A wide variety of terrestrial animals is found in the Coniferous Forest Biome. Under pristine conditions, the three basic requirements of food, water and cover are usually well met for most species. This Biome produces a conifer overstory from timberline to the ocean, and from above the Arctic Circle to near the Mexican border. Some adaptable species are found throughout the Biome. Others are much more specific in their requirements. In general, the Coniferous Forest Biome is characterized by the following terrestrial wildlife families.

- Mammals. Deer (Cervidae), bears (Ursidae), wolves, coyotes and foxes (Canidae), Squirrels (Sciuridae), wildcats-couger (Felidae), weasels (Mustilidae).
- Birds. Hawks (both Accipitrinidae and Buteonidae), eagles (Buteonidae), owls (Tytonidae and Strgidae), grouse (Tetraonidae), woodpeckers (Picidae), finches and sparrows (Fringillidae).
- Reptiles and Amphibians. True toads (Bufonidae), true frogs (Ranidae), garter snakes (Colubridae).

Wildlife typical of the Biome are generally adapted to a closed canopy of coniferous timber interspersed with small openings. Some species, such as the herbivores, respond to an edge effect created by forest meadows, logging or fires that allow development of a nutritious understory of vegetation. Other species, including the raptors and larger predators, may respond adversely to loss of the timber overstory, especially if it is accompanied by human activity. Accipter hawks and northern spotted owls depend on tree dwelling mammals for their prey, such as the red-backed mouse, red and flying squirrels, and the small birds that are found in forested areas. Bald eagles and ospreys need dead and dying trees adjacent to lakes, streams and the ocean for nest sites since their prey is principally fish.

Many fur-bearers and birds in this Biome are adapted to a semi-aquatic habitat, and the presence of streams, lakes and ponds add greatly to the variety of wildlife. In a so-called "Virgin forest" this is usually not a limiting factor. Most forest wildlife can adapt to certain habitat changes, but extensive management activities can be greatly detrimental to many species, especially when accompanied by vehicles and people.

The following endangered wildlife species are found in the Coniferous Forest Biome:

- Northern Rocky Mtn. wolf (Canis occidentalis) Wyoming and Montana
- San Joaquin Kit Fox (Vulpes velox) California
- California condor (Gymnogyps califorianus) California
- Columbian whitetailed deer (Odocoileus virginianus leucurus)

- Southern Bald Eagle (Haliaeetus leucocephalus)
  South of 40th parallel

- American peregrine falcon (Falco peregrinus anatum) U.S.A.

- Arctic peregrine falcon (Falco peregrinus tundrius) U.S.A.

a. The Northwest Coastal Forest

This sub-biome supports wildlife habitat where water is usually not a severe limiting factor; humidity is high and the temperature range is narrow. There is usually a deep layer of duff and organic soil rich in micro-organisms. Forests with dense closed canopies produce shade resulting in a poorly developed understory.

- Mammals. Roosevelt elk (Cervus canadensis roosevelti), black-tailed deer (Odocoileus hemionus columbianus), black bear (Euarctos americanus), bobcat (Lynx rufus), lynx (Lynx canadensus), couger (Felis concolor), coyote (Canis latrans), Mtn. beaver or Sewellel (Aplodontia rufa), white-footed deer mouse (Peromyscus maniculatus), snowshoe hare (Lepus americanus), Douglas chickaree (Sciurus douglasii), mink (Mustela vison).
- Birds. Pacific horned owl (Bubo virginianus pacificus), northern spotted owl (Strix occidentalis caurina), Cooper's hawk (Accipter cooperi), bald eagle (Haliaeetus leucocephalus), sooty grouse (Dendragapus fuliginosus), winter wren (Nannus hiemalis pacificus), band-tailed pigeon (Columba fasiata fasciata).

- Amphibians and Reptiles. Pacific giant salamander (Dicumptodon ensatus), Puget Sound garter snake (Thamnophis sirtalis).

Other wildlife are found in more specific vegetative zonal types: the hemlock looper (Ellopia fascellaria lugubrosa) and the Sitka spruce beetle (Dendroctonus obesus) are serious defoliations found in the Sitka spruce zone.

In the western hemlock (or coastal Douglas-fir) zone, the little Trowbridge's shrew (Sorex trowbridgii t.), an insectivore, also feeds on Douglas-fir seed. The Douglas-fir bark beetle (Dendroctonus pseudotsugae) is also found.

The fisher (Martes pennanti pacifica) and the rare flammulated owl, (Otus flammeolus) are found in the silver fir and hemlock zones below timberline.

Above timberline the alpine zone is typified by the wolverine (Gulo luscus), and further north, the white crowned sparrow (Zenotrichia leucophrys).

Most of the general habitat requirements previously mentioned pertain to this sub-biome. This sub-biome has the ability to rapidly produce desirable habitat following fires, logging, and other disturbances to the overstory than Taiga and Montane forests. This is due to sites, soils, moisture, and elevations. Water is not usually a limiting factor.

Deer and elk generally follow any natural or man-made opening of the dense overstory, such as caused by fires or logging, to take advantage of resulting nutritious ground vegetation.

The cougar, black bear, northern lynx, and Alaskan grizzly bear inhibiting this sub-biome are wilderness species that need the seclusion and escape cover afforded by dense forests.

Many of the small mammals and birds, and amphibians found in coastal forests depend on the variety of insect life that abounds in the damp, mild environment, as well as the great mass of nutritious seeds produced by evergreen trees.

Mink, marten, otter, beaver and muskrat abound in this habitat due to the proximity of lakes and streams that afford food, bank dens, and travel routes. While waterfowl are not normally considered as representative birds of timbered habitat, many ducks use the lakes, rivers and estuaries adjacent to the moisture-holding forest lands. Some ducks, including the golden-eye, bufflehead, and wood duck, nest in tree cavities immediately adjacent to water.

b. Montane Coniferous Forest

A much greater variety of habitat exists in this sub-biome than in the coastal forest or taiga, due to the variety of vegetative types. This allows a high degree of use by adaptable wildlife. Some 56 species of breeding birds have been recorded in the central Rocky Mountains. Representative wildlife includes:

- Mammals. Rocky mountain elk (Cervus canadensis nelsoni), mule deer (Odocoileus hemionus hemionus), mountain goat (Oreamnos americanus), Rocky Mtn. bighorn (Ovis canadensis canadensis), couger (Felis concolor), black bear (Euarctos americanus), fisher (Martes pennanti), pika (Ochotona princeps), Rocky Mtn. cotton-tail (Sylvilagus nuttalli).

- Birds. Golden eagle (Aquila chrysaetos canadensis), screech owl (Otus asio), grey-crowned rosy finch (Leucosticte tephrocotis), three-toed woodpecker (Picoides tridactylus), white-tailed ptarmigan (Lagopus leucurus), American magpie (Pica pica budsonia) Clark's nutcracker (Nucifraga columbiana).
- Amphibians and Reptiles. Pacific tree frog (Hyla wrighorum), California mountain kingsnake (Lampropelis zonata).

As with the coastal forest sub-biome, many other wildlife species are found by regions of the biome.

The southwestern Oregon-northern California area has such typical species as the ringtailed cat or cacomistle (Bassariscus astutus oregonus) found along the lower areas of the "mixed conifer-mixed evergreen" zone. The Douglas ground squirrel (Otospermophilis grammurus douglasii) is common in the mixed forests of this area. The California, or acorn woodpecker (Balanosphyra formicivora) also represents this area, and the Northern Pacific rattlesnake (Crotalis viridis) is present in the transition zone area. Destructive beetles, such as the bark beetle (Ips emarginatus) infest ponderosa pine. This zone may have heavy blacktailed deer concentrations rather than mule deer populations.

The eastern Oregon - Washington and northern Rockies portion of the Montane forest may be represented by the Cascade hoary marmot (Marmota caligata canadensis), and mountain caribou (Rangifer montanus), moose (Alces americana shirasi), grizzly bear (Ursus horribilis), American pipit (Anthus spinoletta), and the boreal toad (Bufo boreas).

In the central and southern Rockies, the Kaibab squirrel (Sciurus kaibabensis) and the tawny deer mouse (Peromyscus maniculatus rufinus) are important species.

Water can be a limiting factor in the Oregon habitat requirements of this sub-biome. The diversity of habitat and climatic conditions produces a diversity of wildlife. Woodpeckers make extensive use of the oaks and other hardwoods found in parts of this sub-biome for food, food storage and nesting. Many other birds and small animals also use cavities in dead and dying trees as nest and den sites. The many herbivores inhabiting this sub-biome utilize most of the upper areas as summer range. Deep snows and cold preclude year-round residency, especially for deer and elk. These ruminants seek suitable winter range within reasonable migration distance for survival. High mountain meadows, and vegetation above timberline is typical sheep and goat year-round habitat.

As noted for other timbered areas, the larger predators--wolverine, wolves and grizzly bears, and cougar--require the privacy of wilderness to survice.

The open forests in the southern part of this sub-biome merge into the Upper Sonoran zones of California and the southern Rockies. These warm, dry fairly open timbered stands are inhabited by the birds, animals and reptiles using drier sites; they are typified by the Kaibab squirrel, ringtailed cat, rattlesnakes, lizards, and pinon jay.

c. Taiga Coniferous Forest

Most of the animals in the Taiga Forests are shy and retiring. They can tolerate cold winters with much snow. The herbivores are largely browsers. Some, such as the moose, snowshoe hare, and grouse, depend (at least in part) on broad-leaved plant communities found in burns or natural openings, and along streams.

The Taiga has an enormously important seasonal cycle conspicuous in the dormancy of its invertebrates and of many vertegrates, and in the spring influx and autumn departure of migratory birds. Outbreaks of certain insects, particularly bark beetles and defoliators, result in destruction of large areas of forest. About fifty species of insects are important. The spruce budworm and the tent caterpillar are dominants and important everywhere.

Animals commonly found in the Taiga include:

- Mammals. Wolverine (Gulo luscus), lynx (Lynx canadensis mollipilosus), snowshoe rabbit (Lepus americanus macfarlani), red squirrel (Sciurus hudsonicus petulans), Artic caribou (Rangifer torandus granti), moose (Alces gigas), Alaska porcupine (Erithizon epixanthum myops), Alaska least weasel (Mustela rixosa eskimo), Northern flying squirrel (Glaucomys sabrinus yukonensis), Alaska marten (Martes americana actuosa), hoary bat (nycteris cinera).

The moose, Dall sheep, and mountain caribou are found principally in the timbered mountains in the southern part of this sub-biome.

- Birds. Gyrfalcon (Falco rusticolus obsoletus), snowy owl Nyctea nyctea), Arctic horned owl (Bubo virginianus subaracticus), spruce grouse (Canachites canadensis), ptarmigan (Lagopus leucurus), Arctic three-toed woodpecker (Picoides arcticus).
- Reptiles and Amphibians. True frog (Rana sylvatica).

As far as habitat requirements are concerned, the timberlands of the Taiga, although generally sparse, do provide necessary winter shelter as well as food for browsing herbivores, the ruffed grouse, and other birds and animals. The adaptable barren ground caribou can dig through two feet of snow and reach the desirable reindeer mosses, sedges, and lichens if browse species are not available.

Predator-prey relationships are definite, with larger predators, such as the lynx and great horned owl populations, dependent principally upon the presence of the varying hare, that is in turn dependent on low shrubs.

2. Wildlife - Aquatic[75-81]

The aquatic animal communities in the Coniferous Forest Biome of the western United States are of rather specific diversity and species. The biome is generally characterized by high quality, near neutral water, and low water temperature with fair numbers of aquatic organisms in the streams and rivers. This biome also support significant warm water fisheries and high quality warm water biotic communities. Presently, however, this aquatic environment is being underutilized and doesn't receive the attention of the cold water aquatic community.

Lower elevation lakes and reservoirs become more productive if constant flushing is not a factor in loss of nutrients. The waters generally start at high elevations, especially in the Montane Sub-Biome. The large rivers formed from tributary streams may have significant changes in water quality from higher to lower elevations provide subtle changes in the aquatic ecosystems. In general, the Coniferous Forest Biome is characterized by some of the following typical aquatic animals.

- Fish. Trout, salmon and whitefishes - Salmonidae
- Invertebrates. Freshwater clams and mussels - Pelecypoda
  Freshwater shrimps and crayfish - Decapoda
  Mayflies, stoneflies, caddis - Insecta

In addition, the Northwest Coastal and Montane biomes support striped bass, shad and sturgeon.

The following endangered fish are found in the Coniferous Forest Biome:

Gila trout - Salmo gilae (New Mexico)
Lahontan cutthroat trout - Salmo clarki henshawi (California, Nevada)
Humpback chub - Gila cypha (Arizona, Utah, Wyoming)
Colorado River squawfish - Ptychocheilus lucius (Colorado River system)
Woundfin - Plagepherus argentissimus (Utah)

The aquatic animals typical of the Biome are adapted generally to habitat conditions of the highest quality of food, water and cover. General minimum water quality standards set by state and federal regulations may not be adequate for protection of these organisms. In many states, specific regulations are designed for waters in these higher watersheds.

The animals have adapted to stream habitat that is generally of coarse material free of fine clays, sand and silt. Organisms that have adapted to slow moving and silt laden rivers are generally absent in Coniferous Forest waters. Some animals may be found in the transition areas, but are on the fringe of their normal habitat.

Water requirements considered optimum for complete life histories of aquatic animals in the Biome are as follows:

Dissolved oxygen	- 7 - 9 ppm
Hydrogen Ion (pH)	- 6.8 - 7.8 ppm
Total dissolved solids	- 150 ppm
Jackson Turbidity Units	- 5 or less
Water temperature	- 50° - 60°F

The larger animals, like fish, can withstand more extremes in changes of water quality than organisms such as aquatic insects and crustaceans.

Aquatic insects, phytoplankton and crustaceans have adapted to larger substrate such as rocks and gravel. Streams have generally stabilized in heavy forested areas and contain optimum amounts of riffle and pool areas. Most streams develop the aquatic organisms in the faster moving riffle-gravel-rubble areas.

Fish have adapted to high water quality, low water temperatures and stabilized streambanks. Vegetation along with streams is extremely important in keeping the protective cover and shading of the stream intact. For reproduction, salmonid fish need gravel of a size range from 1/2 to 5 inches in diameter for deposition of eggs during sprawning and rearing of the ova. Optimum size of the gravel depends on the species of fish. Good, clean silt free gravel is an important habitat requirement in the aquatic ecosystem of the Coniferous Forest Biome.

a. Northwest Coastal Coniferous Forest

The Northwest Coastal sub-biome supports a major portion of the sport and an internationally exploited commercial anadromous salmon populations. All five species of Pacific salmon are found in these waters.

Chinook salmon - *Oncorhynchus tshawytscha*
Sockeye salmon - *Oncorhynchus nerka*
Coho salmon - *Oncorhynchus kisutch*
Chum salmon - *Oncorhynchus keta*
Pink salmon - *Oncorhynchus gorbuscha*

Several indigenous trout characterize the sub-biome. These fish provide a sport fishery of high annual importance in all Pacific Coast states and Canada.

Rainbow trout (steelhead) - *Salmo gairdneri*
Coastal cutthroat trout - *Salmo clarki clarki*
Dolly Varden trout - *Salvelinus malma*

Miscellaneous indigenous fish typical to the sub-biome include species such as the following:

Whitefish - *Prosopium williamsoni*
Squawfish - *Ptychocheilus oregonensis*

Red-sided shiner - Richardsonius balteatus balteatus

Coarse-scaled sucker - Catastomus macrocheilus

Pacific lamprey - Entosphenus tridentatus

Sculpins - Cottidae

The Northwest Forest sub-biome also surrounds hundreds of important estuaries on the Pacific Coast where freshwater from the forest drainages meet and intermix with the salt water of the ocean. The estuaries support a variety of marine species and juvenile life stages of anadromous fish. Typical examples, in addition to the Pacific salmon, are:

Seaperches - Embiotocidae

Flounders - Pleuronectidae

Eulachon (smelt) - Thaleichthys pacificus

Dungeness crab - Cancer magister

Cockle clam - Clinocardium nuttalli

Washington clam - Saxidomus giganteus

Habitat requirements of aquatic organisms are generally the same as stated for the entire Coniferous Biome. It is emphasized that the special requirements for anadromous fish are especially important in the Northwest Coastal area. Adult fish migrating from the ocean through the estuaries and to the gravel spawning grounds need special consideration. During the migration period the fish may be able to pass through waters of high turbidity, but must have water of good quality on the spawing grounds. Routes of access to the spawning grounds must not be blocked by obstructions such as dams, culverts, or debris. The ova, after deposition in the gravel, require high quality water and freedom from disturbance for periods as high as three or four months. Fry and fingerling need quality water, cover and food during their freshwater life before migration to the sea. Freshwater life of the small fish varies from a few months to several years depending on the species.

b. Taiga Coniferous Forest

The Taiga Forest sub-biome provides an aquatic ecosystem characterized by high quality water, low water temperatures, alpine lakes, ponds and bogs in various stages of life. The larger river systems contain commercially important populations of anadromous pacific salmon.

The Alaska Bristol Bay sockeye fishery is of international importance and one of the largest migratory animal populations in the world.

Sockeye and chum salmon are the most numerous. Other fish typical of the Taiga Forest are as follows:

Arctic grayling - Thymallus arcticus
Whitefish - Coregonus sp.
Inconnu (sheefish) - Stenodus leucichthys
Lake trout - Salvelinus namaycush

The freshwater environment in the Taiga is generally low in aquatic organisms. The reduced food supply combined with lower water temperatures provide a habitat contributing to the slow freshwater growth rate of fish. The high quality water, however, provides a medium for good hatching and rearing of anadromous species of fish. Rapid growth is obtained after the fish move into the productive estuaries and oceans.

A variety of plaktonic animal forms provide most of the food in lakes for species such as sockeye salmon. Other invertebrates important in these waters are aquatic insects such as mayflies, stoneflies, caddis and various diptera.

In addition to the habitat requirements stated in the other sub-biomes conditions in the Taiga are generally of a pristine nature. Many of the larger river systems are of glacial origin and constantly turbid from silt. These rivers are routes of access for anadromous fish to the clear, high quality spawning and rearing tributaries. The character of most of the important fish producing streams is preserved by the thin riparian stand of white spruce forest.

c. Montane Coniferous Forest

Migratory and anadromous species of fish are normally absent except in some areas of northern California, Idaho, and Oregon. The forested area waters are characterized by salmonid species of fish such as trout and whitefish. Transition areas occur within the fringes of the Montane Forest because of changes in water quality, such as higher temperatures and turbidities. In these areas are found, along with reduced salmonid populations, largemouth and smallmouth bass, northern pike, crappies and several species of cyprinids, such as squawfish, chubs, and suckers.

The high quality waters support freshwater clams and mussels, and good populations of crustaceans and aquatic insects.

Typical fish in the Montane Forest sub-biome are as follows:

Cutthroat trout - Salmo clarki sp.

Rainbow trout - Salmo gairdneri

Whitefish - Coregonus and Prosopium

Introduced trout have also become established and are now typical of the area.

Brook trout - Salvelinus fontinalis

Brown trout - Salmo trutta

Lake trout - Salvelinus namaycush

Other endemic fish distinctive to the sub-biome are:

Dace - Rhinichthys sp.

Suckers - Catostomidae

Probably the most important habitat requirement is silt-free water with temperatures of less than 70° . Diversions of water for irrigation and a variety of consumptive uses are now impacting the aquatic habitat in this Biome. Consistent water temperatures of over 70°F during summer months invite a reduction of salmonid fish and an increase in warm water species. A variety of land management abuses may increase the amount of silt in streams and lead to changes in aquatic fauna. High riparian vegetation along streams is important in holding water temperatures below 70°F for protection of salmonid fish.

3. Domestic Livestock

Grazing by livestock occurs throughout the Coniferous

Forest Biome, with the exception of the Taiga, in the more open areas and sparse timbered stands where water and desirable forage species are present. Cattle, sheep and a few horses graze these areas as part of established livestock operations. In addition, some relatively minor grazing use is made in connection with recreational activities. Most livestock use occurs between April 1 and October 31.

Domestic livestock utilize a wide variety of plant species in the Northwest Coastal and Montane Coniferous Forests. Some of the more common are: Blue wild-rye (Elymus glaucus), Kentucky bluegrass (Poa pratensis), tufted hairgrass (Deschampsia caespitosa) and Mountain bromegrass (Bromus marginatus). The diet of domestic grazing animals consists primarily of grass and forb species in the spring and early summer months. As the season progresses these plants mature and lose their high protein content. Grazing use than shifts more to browse species which maintain a higher protein content during the late summer and fall. Livestock grazing is extremely limited on BLM forest lands with some taking place in southwestern Oregon and the remaining contiguous states.

J. Micro and Macro-organisms

1. Soil Organisms

Throughtout the Coniferous Forest Biome minute forms of plant and animal life spend their lives at or below the forest floor and are essential to the existence of plants and larger animals. They are a vital part of the cyclic pattern of matter in nature and are the tools with which nature fashions soil from lifeless geologic matrix and plant and animal residue.[82]

Each year most forest floors (with the probable exception of the Taiga) collect an average of two tons of plant and animal debris per acres.[83] This residue becomes the source of life for minute soil flora and fauna which feed upon and gradually decompose the debris. The decomposition releases back to the energy cycle the inorganic compounds necessary for the manufacture of new organic matter.

Numerically, microscopic forms such as bacteria, fungi, and certain molds and algae, predominante. Microscopic protozoa are the most abundant animals. Other tiny animals such as mites and springtails, barely visible to the naked eye, may number 200 million per acres. Many of these minute plants and animals occur world wide, in arctic tundra as well as temperate and tropical forests.

Of the variety and abundance of micro-organisms occurring in forest soils, bacteria, fungi, and actinomycetes are of critical importance in the biochemical energy flow.

Although many types of bacteria are normally present, their collective importance stems from their ability to decompose organic remains and increase the availability of nutrients through oxidation, evolution of carbon dioxide, and symbiotic association with the roots of trees and lesser vegetation. Fixation of atmospheric nitrogen into compounds available to the forest vegetation is accomplished largely by bacteria.[84]

Fungi and fungus mycelia have a part in the decomposition of virtually every leaf or needle that falls to the forest floor. They decompose proteins, cellulose, carbohydrates and lignins. Certain parasitic fungi invade living root tissues causing the eventual destruction of the plant. Other fungi develop symbiotic associations with the roots of trees and higher plants, permitting mutually beneficial exchange of carbohydrates, nutrients, and other growth-promoting substances.[85]

Actinomycetes exhibit characteristics of both fungi and bacteria. Their importance is associated with their ability to produce antibiotics of high toxicity to certain pathogenic organisms. Certain actinomycetes form symbiotic unions with alder roots, permitting fixation of atmospheric nitrogen.[86]

Other important forest soil organisms are nematodes, rotifers, ticks, larvae, millipeds, centipeds, ants, beetles, spiders, and worms.

Although most of the foregoing soil organisms occur throughout the Montane and Northwest Coastal Coniferous Forests, their presence in the Taiga may be less abundant and restricted to the smaller forms.

2. Aquatic Organisms

Minute organisms that live at the surface, within and on the bottome of streams, lakes and estuaries form significant links in the energy flow of the aquatic ecosystem. While there are some variations in species make-up between sub-biomes they are described on the basis of the Coniferous Forest Biome.

Aquatic organisms fall into three basic classes, (1) autotrophic (self-nourishing) or producer organisms, chiefly tiny plants, (2) heterotrophic (other-nourishing) consumer organisms, chiefly animals, and (3) a second category of heterotrophics known as reducers, mostly bacteria and fungi.

- Autotrophic (producer). Green plants assimilate inorganic nutrient minerals - usually by photosynthesis - into living organic substances. The largest group of energy producers are tiny algaes, diatoms, and flagellates. Collectively they are at the bottom of the food chain. Those that are found floating free are known as phytoplankton.
- Heterotrophic (consumer). Animal organisms feed upon and digest plant and other animal organic matter, releasing energy in the process. They occupy the next level upward in the food chain and are known a zooplankton. Included are microscopic protozoa and rotifers and larger animals such as sponges, snails, worms and daphnia.
- Heterotropic (reducers). Bacteria and fungi that decompose more complex organic remains, returning the inorganic minerals for reuse at the start of the energy cycle, releasing the remaining chemical energy in the process.

Stability of the aquatic ecosystem depends upon the degree of equilibrium achieved between the autotrophic and hetertrophic sectors.[87]

K. Human Settlement and Land Use

1. Montane Coniferous Forest

The history of white man's early settlement of the Montane

Coniferous sub-biome began with the search for gold and silver, fur bearing animals and exploration of newly acquired territory.

Although some early settlement had taken place in the Southwest on Spanish land grants, it was only after the West became United States Territory, in 1846 and 1848, that the cross-country movement of pioneers gained momentum and the economic development of the West began.

Landform was the primary determinant of early settlement patterns. After crossing mountain saddles, the pioneers usually followed the rivers and valleys and spread out in the basins and plains. They preferred river banks and adjacent uplands for settlement. The rivers provided transportation and the trees growing nearby provided wood for home construction and fuel.

Settlement gained momentum when the vanguard of settlers reached the plains. Settlement and development of the public domain was further facilitated through passage of various public land laws. These laws were designed to provide title to tracts of land, varying in size from 160 to 640 acres, upon compliance with occupancy and use conditions. Settlement envisioned by laws in force at that time (Timber and Stone Act, Preemption Act, Homestead Act) were meant to populate the nation and provide sustenance and homesteads to the people. Instead, graft and fraudulent manipulation of these acts often put the choice timberlands into the hands of timber companies and speculators.

Settlement, however, was only the initial step in development. Settlers who had located on the land could not remain isolated members of society. They were followed closely by churches and schools. Frontier towns and trading centers sprang up over the country. Travel to the West was greatly facilitated when, in 1869, the central transcontinental railroad was opened. Soon followed by other trunklines, these railroads pierced the frontier and ran ahead of settlement.[88]

Although settlement and development took place rapidly in the more fertile valleys and plains, the establishment of permanent settlements in the mountainous terrain that comprises the Montane sub-biome took place in a much different fashion. Characterized by steep, rugged topography with shallow, poorly developed soils, the mountains afforded little opportunity for homesteading. Exceptions occurred in sheltered fertile valleys between the ranges.

Mining of gold and silver, and later timber harvesting, were the principal attractions of the western mountains. Although many of the early mining settlements have either disappeared or are ghost towns today, others, more favorably situated, survived. In certain locations, mining still provides significant income and employment. Many rural counties in Colorado, Idaho, Montana, Wyoming, Washington and Oregon which had their greatest population prior to 1920 have since decreased. Large National forests and parks in the area have virtually no permanent year-round habitation. Forest products, mining, agriculture, and tourism are the main-stays of the economy. Lumbering and livestock grazing occur generally throughout the Montane sub-biome.

Livestock grazing of the alpine meadows is normally limited to the summer months, with the animals being moved to lower ranges, outside the sub-biome, during the fall and winter.

Although most of the forest lands within the region are inside National Forests, and are administered by the Forest Service, the BLM administers 1,631,000 acres of commercial forest on the public land within the region, from which $1,808,000 was received from sale of timber in 1971.* [89]

Communities tend to be small, and are oriented to logging, ranching or mining which may occur in the area. A phenomenon that began after World War II and has increased alarmingly in some parts of the region having non-existent or weak local land use controls has been the development of "speculative" homesites. Frequently located in remote rural areas, these recreation sub-divisions have sometimes failed to develop as portrayed in the sales brochures.

Recreation-tourism is growing rapidly in importance throughout the sub-biome. In areas with outstanding resources, such as Yellowstone Park area, or Aspen, Colorado, tourism is the mainstay for local communities. The Pacific Crest Trail, routed along the crest of the Cascade Mountains, stretching from Canada to Mexico, leads to points of scenic beauty accessible only by pack horse or foot and annually receives increased use. Throughout the Montane region Federal, state, county, and municipal organizations as well as private enterprises have been active in the development of scenic and recreation resources. Hunting, fishing, sightseeing, picnicing and camping, and winter sports are the predominant types of recreation activities.

---

*Excluded from these figures are the O&C lands administered by the BLM in Jackson and Josephine Counties in Oregon. Although they are within the Montane sub-biome, O&C land data pertaining to them are included with the other O&C Counties under the Coastal sub-biome section.

Although much of the Montane Coniferous Forest lies within the National Forest system, the BLM has developed 117 recreation sites containing more than 2400 camping, picnicing and trailer units on the Bureau administered public lands of the region.* There are additionally over 8000 miles of stream and more than 5 million acres of lakes and reservoirs on these public lands within and adjacent to the Montane sub-biome available for fishing and other water-oriented recreation.[90] Additionally, most of the public land within this sub-biome is open to hunting. Collectively, recreation visits to the Bureau administered public lands within and adjacent to the Montane sub-biome were estimated at more than 37 million during 1971.[91]

---

*Figures are exclusive of the public land states of Nevada, Alaska and Oregon west of the Cascades which are outside the Montane sub-biome. Also not all of these recreation sites occur within the Montane sub-biome, but lie in adjacent biomes.

Figures 19 and 20 show land ownership patters for all three Coniferous Forest sub-biom.

2. Northwest Coastal Coniferious Forest

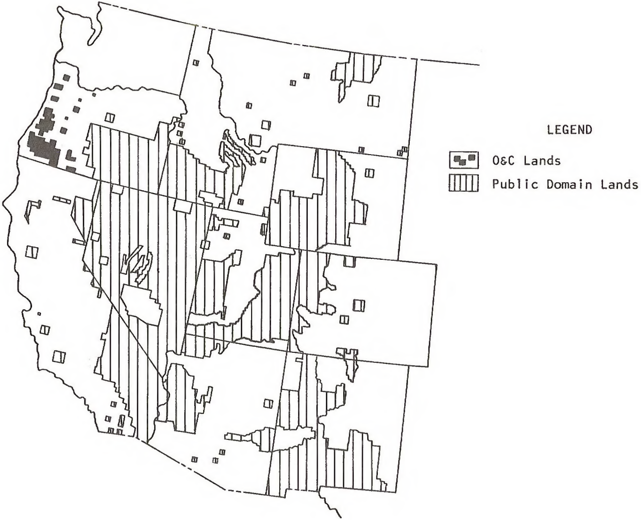
The history of early settlement of the Coastal Forest region followed essentially the same pattern as the Montane region to the east. Although rough and mountainous for the most part, the region contains some of the most productive softwood forests in the United States. Often referred to as the Douglas-fir Region for the principal tree species found there (except along the Alaska Coast), other valued softwoods are cedar, hemlock, spruce and true fir.

The gold rush and subsequent population growth in California afforded the first export market for the region's vast supply of mature timber. This market expanded into the developing Midwest with the extension of intercontinental railroads into the Pacific Northwest in 1880's and 1890's. Production of wood products for a national market was the single most significant economic factor contributing to the rapid population growth of the region into the 1920's.

Lumbering and wood products industries contine to play an important role in the economy. In 1968 the Pacific Northwest Forest and Range Experiment Station estimated the degree of economic dependency upon timber industries of selected areas within the Douglas-fir Region of Washington, Oregon and California. Dependency was measured as a percent of total economic (or export) base employment attributable to timer dependent industries. The researchers found that

FIGURE NO. 20

LAND ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT



ALASKAN LANDS ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT

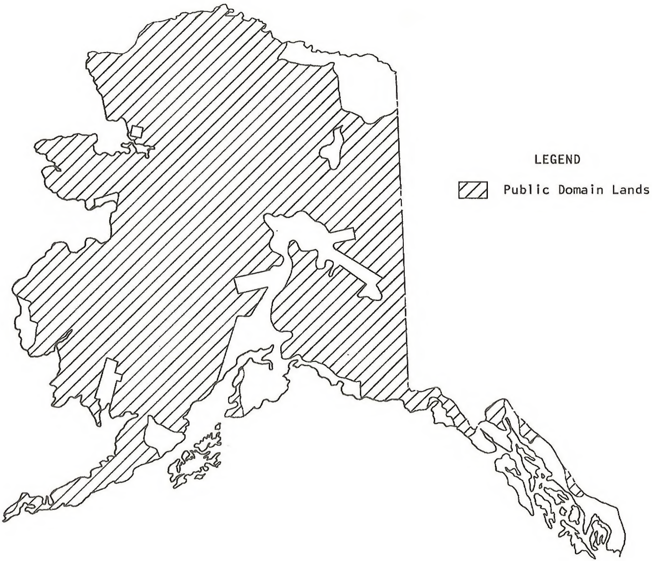


FIGURE NO. 21

timber dependent industries accounted for approximately 45 percent of the regions economic base employment. Table VII shows timber-dependency ratings for 15 economic areas within the region.[92]

TABLE VII

CLASSIFICATION OF ECONOMIC AREAS BY DEGREE OF DEPENDENCY UPON TIMBER-BASED EMPLOYMENT

Dependency	Economic Area*	Percentage of 1960 excess employment dependent on timber-based employment
Slight	Seattle	6.2
	Portland	23.8
	Salem	29.3
Moderate	Bellingham	30.4
	Tacoma	32.5
	Astoria	63.1
High	Medford	70.0
	Corvallis	74.3
	Eugene	76.6
	Longview	81.5
	Aberdeen	88.1
	Eureka	89.6
	Port Angeles	90.5
	Coos Bay	91.6
	Roseburg	99.4

* Economic areas are identified by the names of their respective growth centers.

Note: The authors used the excess-employment technique to determine the portion of employment in an area which was engaged in economic base activities. This approach considers any industry in an area with employment in excess of the national norm for distribution of employment among industries to be producing for export. The percentage of total excess (export) employment (the total may include several industries, basic as well as service, for an area) attributable to timber related industries is computed and defined as the timber-dependency indicator (figures in the right-hand column of Table VII).

The Northwest Coastal sub-biome of western Oregon, Washington and northwestern California contains over 2.5 million acres of commercial forest administered by the Bureau of Land Management. The western Oregon lands, comprised of both the O&C and public domain, are generally recognized as one of the nation's most productive and valuable commercial forest properties.* During fiscal year 1974 approximately 1.2 billion board feet of timber worth $212 million were sold from the 1.9 million acres located in western Oregon. In this fiscal year $57.8 million were distributed to the 18 O&C counties under terms of the O&C Act of 1937 and subsequent agreements.[93]

The O&C lands contribute 17.5 percent of the timber harvest in western Oregon. In this same area timber-dependent industries account for 45 percent of the total economic base employment. This dependency ranges from a low of 24 percent in the Portland area to 99 percent in the Roseburg area (Table VII). Thus the O&C lands contribute approximately 8 percent of the total western Oregon economic base employment.[94] The significance of these lands to local and regional economies is further exemplified by the fact that 17 percent (13,500)

---

* Although Jackson and Josephine Counties are within the Montane Forest sub-biome for purposes of clarity O&C data from them are lumped with the O&C counties in the Coastal sub-biome.

The Northwest Coastal sub-biome of western Oregon, Washington and northwestern California contains over 2.5 million acres of commercial forest administered by the Bureau of Land Management. Comprised of both the O&C and public domain, these lands are generally recognized as one of the nation's most productive and valuable commercial forest properties. During fiscal year 1971 approximately 1.23 billion board feet of timber worth $52 million were sold from 1.9 million acres of O&C land in Oregon. From this $31.8 million were distributed to the 18 O&C counties under terms of the O&C Act of 1937 and subsequent agreements.* During fiscal year 1972 the value of 1.19 billion board feet sold was $65.5 million of which $37.7 million were distributed to the counties (receipts to the counties include revenues from sale of timber for O&C lands (the largest source), grazing fees, mineral fees, rental and sales of land, and from other sources).[93]

The O&C lands contribute 17.5 percent of the timber harvest in western Oregon. In this same area timber-dependent industries account for 45 percent of the total economic base employment. This dependency ranges from a low of 24 percent in the Portland area to 99 percent in the Roseburg area (Table VII). Thus the O&C lands contribute approximately 8 percent of the total western Oregon economic base employment.[94] The significance of these lands to local and regional economies is further exemplified by the fact that 17 percent (13,500) of the 78,000 persons employed in the lumber and wood products industry in western Oregon in 1965 could attribute their jobs to the O&C timber cut. Payrolls were $89.5 million and the value added to the economy, including the value of timber cut, was $187.1 million. This compares with the value of total products sold on farms of the 18 counties of $245 million. It is greater than the value added by any other Oregon industry, with the exception of the total lumber and wood products industry.[95]

---

* Although Jackson and Josephine Counties are within the Montane Forest sub-biome for purposes of clarity O&C data from them are lumped with the O&C counties in the Coastal sub-biome.

These jobs in the basic industry in turn generated more than 20,000 other secondary employment jobs (retail, service, and other employees serving the basic employees), and supported a total population of about 80,000 (including the employees and their families).[96]

Further north, along the southeast coast of Alaska, is an additional segment of the Coastal sub-biome, however, it lies within the National Forest.

The Pacific Coast forms the western boundary of the Coastal sub-biome. The proximity to the ocean adds to the recreational diversity of the area. Outdoor activities such as swimming, fishing and camping are some of the more common forms of recreation activity. Digging of clams, both commercially and as a form of recreation, takes place on the beaches and inlets all along the coast, reaching the peak of productivity along the Washington coast and the Puget Sound. Fishing the numerous streams that traverse the coastal strip, many on BLM administered lands including such nationally known ones as the Rogue and Umpqua, yield exciting frest-water catches. Saltwater sportfishing has created and supports a growing charter boat industry.

Camping and picnicking is facilitated by the numerous state and Federal parks located along the coast. Further inland, the BLM has developed and administers 59 sites containing over 1200 camping, picnicking and trailer units.[97]

Most of the approximately 3 million acres of BLM administered land in the Coastal sub-biome is available to the public for hunting. Since much of the area is covered by a dense forest, most of the hunting is concentrated in natural or man-made openings such as roads, timber harvest sites or cleared utility rights-of-way. Livestock grazing also occurs in localized areas on the lower, more open sites administered by the Bureau.

The cities of Seattle and Portland are the two principal metropolitan centers in the Coastal sub-biome. The harbor facilities on Puget Sound make the neighboring cities of Seattle and Tacoma major centers of trade with foreign countries and a gateway to Alaska. Supported by the rich agricultural land around it, large accessible timber resources, and a more recent aero-space industry, the Seattle-Tacoma area has had a continuous development since the transcontinental rail lines made it a Pacific terminal.

Further south, at the confluence of the Columbia and Willameette Rivers, the City of Portland is an important trading center. Agricultural products from the rich Willamette Valley flow into and through the city, while the Columbia Gorge provides easy access by rail, interstate highway and water to the Columbia Basin and Snake River Valley to the east. The flow of materials to and from foreign ports passing over the Portland docks mark the city as one of the major Pacific Coast ports.[98] Further south, on the coast, the deep water port of Coos Bay is developing into a major shipping point.

Low cost hydroelectric power, deep water ports, and availability of labor have encouraged industrial growth of the major urban areas.

To the north, along the southeastern Alaska coast, the cities of Sitka, Juneau and Valdez are the principal urban centers. For the most part, settlement of this segment of the Coastal sub-biome is far behind that of the lower portion.

3. Taiga Coniferous Forest

Essentially uninhabited outside the Anchorage and Fairbanks urban areas, this vast region of central Alaska has a population density of only 0.5 perons per square mile. Scattered and remote white and native settlements are lcoated along major river valleys and the limited road systems. In percentage terms, Alaska's rate of growth has been rapid in the past decade with 33 percent increase in population between 1960 and 1970, for a total population of 300,000. Over half of these, 52 percent, live outside urban areas.[99]

Native inhabitants of the sub-biome are the Na-Dene Indian linguistic stock and are highly dependent on fish and wildlife for their livelihood.[100] Summer employment fighting the numberous Taiga wildfires is a source of income to the men. Additional employment is available in the numerous small sawmills that operate part time in the Interior to provide logs and lumber for local use.[101]

The lack of adequate road transportation in this area of Alaska has limited development largely to those areas that are reachable by the few existing roads. Air travel is used extensively throughout the interior. Consequently, much of the region remains wild, remote and inaccessible and represents one of the largest remaining contiquous wilderness areas in the world.

A primary land use in the Taiga is the harvesting of fish and game by the native people and, more recently, by white settlers and recreationists. Some limited use of the timber resource is made by both native and white inhabitants for housing and fuel.

Mining has been the only other appreciable land use in the region--gold mining early in the century and, more recently, oil and gas exploration and development. Oil on Alaska's North Slope and a proposed pipeline crossing the Taiga would drastically affect land use. The introduction of economic and human activity in the pipeline cooridor is covered in depth in the U.S.D.I. Proposed Trans-Alaska Pipeline Final Environmental Impact Statement and other publications.[102]

The remoteness of interior Alaska, the lack of transportation facilities, the extremes in weather, and the sparsity of established communities present monumental obstacles to the development of interior Alaska's timber resources. Most of the better stands of timber occuring in the major river drainages are scattered over great distances and located in some regions where transportation is currently not feasible. The logistical problems and lack of economical transportation makes interior timber non-competitive with more desirable species and size available in the coastal region of Alaska.[103]

A most significant land use of the vast Alaskan interior that can be expected to increase sharply in the future is outdoor recreation. Current estimates shown 9.8 million acres of natural lakes and reservoirs, 50,000 miles of fishing streams, 255 million acres of big and small game habitat (containing 760,000 big game animals) and 67 million acres of waterfowl habitat located on the public lands, most of which are within the Taiga region.[104] Estimated recreation visits to the public lands within the region during 1971 exceeded 5.8 million.[105] In addition, the streams and lakes yielded an estimated 69.5 million pounds of commercial fish harvested in 1971.[106]

Livestock grazing (cattle, horses, sheep, goats and reindeer) took place on approximately 1.5 million acres of public land during 1970.[107]

Although the majority of the land within the Taiga is presently in public ownership, future jurisdiction will depend on relative resource values and the interaction of the Alaska Statehood Act (State selection of public land) and the Alaska Native Claims Settlement Act (PL 92-203).

Climatic extremes severely limit human habitation and land use. Severe winter temperatures, short summers, and wide occurrence of permafrost dictate a careful evaluation of all intensive future land use that may be proposed.

L. Aesthetics and Human Interest Values

In the case of historical and cultural sites the National Register of Historic Places was not consulted since this statement covers some 23 million acres of commercial forest land. For the same reason no other lists or inventories were consulted and no cultural resource surveys were undertaken specifically for the purpose of preparing this statement. Consequently, the full extent of the number of sites on these lands is unknown and those sites that have been identified are not listed because of their exceedingly high number.

1. Aesthetics

The Montane Coniferous Forest and, to a lesser degree, the Northwest Coastal Coniferous Forest, provide some of the most spectacular scenery in the western United States. Such natural attractions as Yellowstone Park, the Grand Canyon and numerous other lesser known sights located throughout the Montane region annually attract hundreds of thousands of sightseers. Further west the Coastal redwood forests of northern California and the rain forests of the Douglas-fir region of western Oregon and Washington offer a more or less continuous panorama of towering forest broken by occasional streams tumbling from the Coast Range Mountain to the Pacific Ocean. Less apparent from the ground except in localized areas, man's intrusion into the coastal forest with roads, power transmission corridors and timber harvest activities create harsh contrasts when viewed from the air.

Land forms vary from the rounded foothills of the Cascades and Coastal Range to the angular peaks of the Rockies, from relatively flat mesas and basins to nearly vertical canyons. Natural lines occur more often in the environment of the Montane than in either the Coastal or Taiga sub-biomes. These may occur as abrupt changes in vegetation types caused by soil changes, avalanche paths or rock intrusions. They may occur as horizontal deposition lines on the face of an exposed cliff or cut bank.

Scale is frequently so vast as to be overpowering to those more accustomed to urban surroundings. The extreme vertical relief common to the mountains is frightening to some. To others the solitude of the mountains and the remoteness of the Taiga Coniferous Forest offer a welcome contrast. The wide variety of forms, textures, colors and natural lines are what make the scenic values interesting, while vastness of scale and distance bring feelings of isolation and solitude to those who live within or visit this region.[109]

2. Geological Human Interest

The Montane contains geologically interesting features left by glaciation. Included are morains, lakes, U-shaped valleys; erosion features like canyons, pinnacle peaks and mudlows; volcanic features such as lava flows, eroded ash beds, dikes, exposed plugs, calderas, hot springs and geysers.[110]

The Taiga also shows evidence of glacial action. Such structures are moraines, drumlins, glacial lakes, and other features occur, along with features associated with permafrost and its actions such as pingos, thaw lakes, beaded drainages, etc.[111]

The Northwest Coastal is edged with an interesting eroded coastline of natural arches, isolated rock islands, sand dunes and steep cliffs. The higher elevations contain canyons, volcanic features, caves and faulting evidence.[112]

3. Archeological Human Interest

Early man's entry into the New World from Asia via a Bering Strait land bridge, estimated to be 1000 miles wide when the seas were at their lowest, is believed to have occured between 20 and 40 thousand years ago. Radio-carbon dated remains going back to about 10,000 B.C. show well-developed stone-clipping techniques and hunting skills adapted to the taking of large animals. Most evidence comes from game kill sites and stratified cave deposits.[113]

The Montane Forest was utilized for food gathering and hunting by the Desert culture that developed in the trans-Rocky Mountain west.

In the Taiga, the Old Bering Sea culture developed into the early stages of Eskimo culture based on the hunting of sea animals.[114] Further inland in the Alaskan interior the sub-Arctic culture, based on the Old Cordilleran and Big Game Hunting traditions, developed into the Northwest Microblade tradition of people who lived by hunting caribou, elk, buffalo and fishing. The Microblade tradition is felt to have provided the core for the Denetasino tradition which became the Athabascan speaking Indians. Archealogical sites are mostly campsites along streams and lakes and on ridgetops with occasional rock shelters.

The Northwest Coastal Coniferous Forest was the home of the Northwest Coast culture. Essentially a river or river-mouth culture, oriented around salmon fishing, the Northwest Coast culture is noteworthy for its vigorous and distinctive art and great use of wood.

Village sites were located along streams and near sheltered inlets along the coast and consisted of both pit and surface houses. Occasional rock shelters and some campsites away from the streams are found.[115]

4. Historical Human Interest

The Montane shares its history with that of the nearby grasslands and desert. Many of the early settlements started as mushrooming mining camps that later blossomed into the present day cities of Baker, Lewiston, Boise and Helena.[116] Most of the early mining camps became empty shells as the ore petered out and their inhabitants moved on to greener pastures. Some of these "ghost towns" such as Montana's Virginia City have survived the ravages of time and today are popular tourist attractions. Other early settlements grew up around military forts and trading posts located along exploration and immigration routes to the West. Today many of these early sites have been given national designations as historical sites and monuments.

The early histroy of the Northwest Coastal developed around fur trading, lumbering, and to a lesser degree, mining. Spain, England, Russia and the United States all laid claim to this region through discovery, exploration, and occupation. One of the earliest white settlements was Astoria, established as a fur trading post by John Jacob Astor's Pacific Fur Company. This company was later sold to the Hudson's Bay Company which relocated the headquarters a hundred miles up the Columbia from Astoria and established Fort

Vancouver, which exists in the present as a national historic site.

Approximately 20 years after the establishment of Fort Vancouver the few American settlers in the Oregon country, tired of living under British laws and the authority of the Hudson's Bay Company, met at Champoeg, near Newberg, and voted to establish a provisional government until Congress would extend jurisdication over them. This was the first American government to be established west of Iowa. Today Champoeg is a State park.[118]

Scattered throughout the Coastal Forest are remainders of the region's early history. Old mining and logging camps, remnants of military posts, and preserved homes of early pioneers are some examples.

The Taiga of Alaska was initially claimed and explored by Russia. Early trading posts and missions (some still in use) were established during the period of exploration. After purchase by the United States the area experienced a gold rush which created numerous "boom and bust" settlements, of which the relics of many still exist. Many of the present native settlements occupy sites that were established hundreds of years ago. Some remain little changed from primitive times.[119]

5. Cultural, Ethnic and Religious Human Interest

Numerous Indian groups currently make their home in various locations scattered throughout or near by the Montane Forest. Most of these reside on the following reservations which extend into the Montane

Forest: Colville, Yakima, Coeur d'Alen, Nez Perce, Flathead, Warm Springs, Crow and portions of the Navajo, Uintah and Ouray, Pueblo, Fort Apache and Tule River Indian Reservations. Many of these groups derive part of their economic and spiritual sustenance from the Coniferous Forest.[120]

The Taiga Forest of Alaska contains one of the largest remaining native American groups still living in much the same way as they have since contact times. They depend to a large extend upon the Taiga for their livelihood.

The Northwest Coastal Forest contains two small Indian Reservations, the Quinalt and Hoopa Valley Reservations. Both rely to some degree on the Coastal Forest for their livelihood.[121]

Bibliography

1. Shelford, V.E., The Ecology of North America, U. of Illinois Press, Urbana 1963, pg. 3.

2. Cook, Wayne C., Colorado State Univ., Interview by BLM, Nov. 2, 1972.

3. Spurr, S.H., Forest Ecology, Ronald Press Co., New York, 1964, pg. 1.

4. Ibid., pg. 11.

5. Ibid., pg. 149.

6. Ibid., pg. 155.

7. Ibid., pg. 158.

8. Shelford, V.E., The Ecology of North America, Univ. of Illinois Press, 1963, pg. 6.

9. McCormick, J., The Life of the Forest, McGraw-Hill Book Co., 1966, pg. 24.

10. See 1 above, pg. 85.

11. McCormick, J., The Living Forest, Harper & Bros., New York, 1959, pg. 20.

12. See 1 above, pg. 84.

13. MacKay, J.R., Future Environments of North America, Natural History Press, 1966, pg. 159

14. Odum, E.P., Fundamentals of Ecology, W. B. Saunders Co., 1959, pg. 389.

15. See 11 above, pg. 53.

16. Eardley, A. J., Structural Geology of North America, Harper & Row, Publishers, New York, 1962, pg. 12, 408.

17. Fenneman, N. M., Physiography of Western United States, McGraw-Hill Book Company, New York, 1931, pg. 98.

18. King, P. B., The Evolution of North America, Princeton University Press, Princeton, New Jersey, 1959.

19. Krebs, R. D., and R. D. Walker, *Highway Materials*, McGraw-Hill Book Company, New York, 1971.

20. Ogburn, Charlton, *The Forging of Our Continent*, American Heritage Publishing Company, Inc., New York.

21. U.S.G.S. Professional Paper 482, *Physiographic Divisions of Alaska* by Clyde Wahohaftig, U.S. Government Printing Office, Washington, D. C., 1965

22. Geothermal Survey Bulletin 1142-H, *Future Petroleum Producing Capacity of the United States*.

23. Geological Survey Circular 647, *Classification of Public Lands Valuable for Geothermal Steam and Associated Geothermal Resources*.

24. Geological Survey, U.S.D.I., *The National Atlas of the United States*, 1970 edition.

25. United States Water Resource Council, *The Nation's Water Resources*, Washington, D. C., 1968.

26. Linsley, Kohler and Paulhus, *Applied Hydrology*, McGraw-Hill, Inc., 1949.

27. DeWiest, J. M., *Geohydrology*, John Wiley & Sons, Inc., New York, 1967.

28. Zon, Raphael, *Climate and the Nation's Forests*, in *Climate and Man-Yearbook of Agriculture*, U. S. Government Printing Office, Washington, D. C., 1941, pg. 478.

29. Zon, pg. 479-482.

30. Zon, pg. 487-497.

31. McCormick, Jack, *The Life of the Forest*, McGraw-Hill Book Company, Inc., New York, 1966, pg. 141.

32. Zon, pg. 493.

33. U. S. Geological Survey, *The National Atlas of the United States of America*, Washington, D. C., 1970, pg. 98.

34. *Climate and Man*, pg. 786.

35. *Ibid.*, pg. 1211.

36. *Ibid.*, pg. 783, 1211.

37. *The National Atlas of the U.S.A.*, pg. 104.

38. *Ibid.*, pg. 102.

39. *Climate and Man* (section on *Climates of the States*), pg. 783-1215.

40. *Ibid.*, pg. 1211, 1212.

41. *Ibid.*, pg. 1215.

42. *Climate and Man*, pg. 234, 272.

43. *The National Atlas of the U.S.A.*, pg. 86.

44. USDA, Forest Service, *Alaska Trees & Shrubs*, Agricultural Handbook No. 40, pg. 15-18.

45. Franklin, W. H., and C. T. Dyrness, *Vegetation of Oregon & Washington*, USDA, Forest Service Research Paper PNW-80, Portland, Oregon, pg. 37-73, 161-173.

46. *Ibid.*, pg. 77-103.

47. Society of American Foresters, *Forest Cover Types of North America*, Washington, D. C., 1954, pg. 42-61.

48. Sawyer and Thornburgh, *Vegetation Types on Grandiorite in the Klamath Mountains*, Calif., Dept. of Biology, Humboldt State College, 1971, pg. 26-27.

49. Franklin & Dyrness, op. cit., pg. 77-103.

50. Minore, Don A., *Classification of Forest Environments in the South Umpqua Basin*, USFS, PNW Exp. Station, Portland, Oregon 1972, pg. 25.

51. Franklin & Dyrness, op. cit., pg. 77-103.

52. *Ibid.*, pg. 110-127.

53. Barrett, John W., *Regional Silviculture of the United States*, 1962, pg. 351-354, 414-418.

54. SAF, op. cit., pg. 42-61.

55. Daubenmire, R., and J. Daubenmire, *Forest Vegetation of Eastern Washington and Northern Idaho*, Washington Agricultural Exp. Station, Washington State University, 1968, pg. 29-47.

56. Franklin & Dyrness, op. cit., pg. 119.

57. *Ibid.*, pg. 110-127.

58. Daubenmire, op. cit.

59. Environmental Protection Agency, *Freshwater Biology and Pollution Ecology*, Training Manual, June 1971.

60. Needham and Needham, *A Guide to the Study of Fresh-Water Biology*, Holden-Day, Inc., San Francisco, Fifth Edition, pg. 101.

61. Steward, A. N., et al, *Aquatic Plants of the Pacific Northwest*, Oregon State College, Corvallis, Oregon, 1960.

62. Hotchkiss, Neil, *Underwater and Floating-Leaved Plants of the United States and Canada*, Bureau of Sport Fisheries and Wildlife, Resource Publication 44, U.S. Government Printing Office Washington, D.C., 1967.

63. Anderson, J.P., *Flora of Alaska and Adjacent Parts of Canada*, Iowa State University Press, Ames, Iowa, 1961.

64. Rydberg, P. A., *Flora of Colorado*, Colorado Agricultural College, Fort Collins, Colorado, 1906.

65. Shelford, V. E., *The Ecology of North America*, University of Illinois Press, Urbana, 1963, pg. 610.

66. Allee, W. C., et al, *Principles of Animal Ecology*, W. B. Saunders Co., Philadelphia, 1949, pg. 837.

67. Odum, E. P., *Fundamentals of Ecology*, W. B. Saunders Co., Philadelphia, 2nd Edition, 1959, pg. 546.

68. Peterson, R. T., *A Field Guide to Western Birds*, Houghton Mifflin Co.

69. U.S.D.I., *Conservation of Endangered Species and Other Fish or Wildlife*, Federal Register, Vol. 35, No. 199, 1970.

70. Skoog, R. O., *Ecology of the Caribou in Alaska*, Ph.D. Thesis, 1970.

71. Cowan, I. M. and C. J. Guiguet, *The Mammals of British Columbia*, A. Sutton, Victoria, B.C., 1965.

72. Bertrand, A. B., and M. A. Scott, *Check List of the Birds of Oregon*, O.S.U. Book Stores, Inc., 1971.

73. Anthony, H. E., Field Book of North American Mammals, G.P. Putman's Sons, 1928.

74. Stebbins, R. C., A Field Guide to Western Reptiles & Amphibians, Houghton Mifflin Co., 1966.

75. American Fisheries Society, Common and Scientific Names of Fishes, 1970.

76. Clemens, W. A. and G. V. Wilby, Fishes of the Pacific Coast of Canada, Fisheries Research Board of Canada, Bulletin 68, 1961.

77. McKee, Jack and Harold Wolf, Water Quality Criteria, California State Water Resources Board, 1963.

78. Miller, Robert Rush, Red Data Book, Freshwater Fishes, IUCN, 1969.

79. Pratt, Henry, Manual of the Common Invertebrate Animals, the Blakiston Company, 1948.

80. U. S. Bureau of Sport Fisheries and Wildlife, Rare and Endangered Fish and Wildlife of the United States, 1968 Edition.

81. Ward and Whipple, Fresh Water Biology, Wiley & Sons, 2nd Edition.

82. Wilde, S. A., Forest Soils, 1958, pg. 43.

83. McCormick, Jack, The Living Forest, 1959, pg. 21.

84. See 69 above, pg. 50.

85. Ibid., pg. 56.

86. Ibid., pg. 63.

87. Environmental Protection Agency, Freshwater Biology and Pollution Ecology Training Manual, June 1971, pg. 1-7, 1-8.

88. Marschner, F. J., Land Use and Its Patterns in the United States, U.S.D.A. Handbook No. 153, 1959, pg. 28.

89. Bureau of Land Management, U.S.D.I., Public Land Statistics, 1971, pg. 63 and Table 40.

90. Ibid., pg. 81, Table 50, pg. 87, Table 55 (Date extrapolated for Montane sub-biome).

91. Ibid., pg. 82, Table 52 (Data extrapolated for Montane sub-biome).

92. Maki, Wilbur, R. Schallan, H. Conn and John H. Beuter, Importance of Timber-Based Employment to the Economics Base of the Douglas-fir Region of Oregon, Washington, and Northern California, U.S. Forest Service, Res. Note PNW 76, 6 pages, 1968.

93. BLM Facts - Oregon and Washington, 1971-72, pg. 4, 5, 6.

94. University of Oregon, Bureau of Governmental Research and Service, The Significance of the O&C Forest Resource in Western Oregon, 1968, pg. 28.

95. Ibid., pg. 40.

96. Ibid., pg. 40.

97. See 80 above, pg. 14, 15.

98. Oregon State University, Atlas of the Pacific Northwest, 4th Edition, 1968, pg. 16.

99. Bureau of the Census, U. S. Department of Commerce, Statistical Abstract of the United States, 1972, pg. 13 and 18.

100. The National Atlas of the United States, 1970 Edition, pg. 132.

101. Murray, Thos. J., & Associates, State of Alaska, Department of Economic Development, Alaska's Commercial Timber Resource, 1970, pg. 22.

102. Bureau of Land Management, U. S. Department of the Interior, Preliminary Draft - Upland Oil and Gas Leasing Programmatic Environmental Impact Statement, 1972, pg. 151.

103. See 88 above, pg. 23, 24.

104. See 76 above, Tables 55, 57 and 58.

105. Ibid., Table 52.

106. Ibid., Table 56.

107. Ibid., Tables 67 and 68.

108. See 89 above, pg. 152.

109. Ibid., pg. 153.

110. Ibid., 153.

111. *Ibid.*, pg. 153.

112. *Ibid.*, pg. 154.

113. See 87 above, pg. 129.

114. *Ibid.*, pg. 129.

115. See 89 above, pg. 154.

116. See 85 above, pg. 8.

117. *Ibid.*, pg. 7.

118. *Ibid.*, pg. 7.

119. See 89 above, pg. 115.

120. See 87 above, pg. 272.

121. *Ibid.*, pg. 272.

III. ENVIRONMENTAL IMPACTS OF TIMBER MANAGEMENT

Section A of this chapter summarizes the significant adverse and beneficial impacts of the individual timber management practices that remain after mitigative measures have been applied and places the impacts in the cumulative or total program context. Section B of this chapter contains a more detailed discussion of the individual impacts of each timber management practice and completely disregards all mitigative measures brought to bear in carrying out a particular practice.

A. Summary of Environmental Impacts of the Program

The reader is reminded that the current Bureau timber management program is generally carried out at three levels: a high level of intensity in western Oregon, a moderate level in the remaining contiguous United States, and a low level or protection-type program in interior Alaska. The projection for the next ten years indicates that the trend towards more intensive management of Bureau administered forests available for timber production (exclusive of Alaska) will continue. Consequently, this summary is primarily directed towards the impacts on the forests in the contiguous western States recognizing that the thrust of the program and therefore the major impacts will continue to be in western Oregon.

An overall characteristic of the current and projected program is to increase the occurrence of the environmental impacts of timber management practices at any given point in time. This in part, because the use of artifical reforestation practices along with other practices reduces the number of years needed to produce crop trees which, in turn, increases the number of acres cut and logged each year. In addition to the impacts stemming directly from intensive management practices, the acreage of mature timber harvested each year is increased during the transition from a predominately overmature forest to a young growth forest because of future expectations of increased wood yields resulting from these practices.

A second overall characterisitic of the program is to increase the frequency of environmental impacts on any given area over time. For example, over time a typical silvicultural regime in western Oregon could eventually include planting, precommercially thinning, fertilizing, commercially thinning and final harvesting a given stand. Under an average rotation of 85 years, the treatments would be carried out as follows: (1) stand establishment in year zero, (2) precommercial thinning in year 20, (3) commercial thinning combined with fertilization in years 30, 40, 50, 60, and 70, and (4) final harvest in year 85. Consequently, the site or stand would be subjected to a series of 14 treatments in the course of 9 stand entries over an 85 year period. There are many different silvicultural regimes resulting in fewer or more treatments, however, the foregoing illustration is fairly representative of the sequential disturbances to which an area available for intensive management will be exposed. As the present overmature stands are replaced with young growth stands over time, the area impacted by the foregoing developmental and interim harvest practices will progressively increase. Nonetheless, as stated in "Processes, Procedures, and Methods to Control Pollution Resulting from Silicultural Practices" (U.S. Environmental Protection Agency Report, EPA 430/9-73-010, "One concludes further that the key to pollution control from a forest dedicated to timber production is intensive, well planned management rather than the laissez faire, let nature take its course, approach."

Because of these program characteristics most of the following environmental impacts must be viewed as occurring both throughout the forest and on a continual basis:

1. Aesthetics and Human Interest. The impact of clearcutting will be greatest in northwestern Oregon with the clearcutting of approximately 17,500 acres annually. An additional 1,500 acres will be clearcut annually in southwestern Oregon and approximately 800 annually in the remaining forests. The unsightly characteristics associated with this practice will adversely impact the environment as perceived by some segments of the public and will be visible for a period of 10 to 15 years following cutting. The noise and dust caused by cutting, logging and transportation practices will interrupt the serenity that is often sought in the forest. While infrequent, wildfires caused by timber management activities will occur and significantly impact aesthetic as will as other values. Conversely, most unsightly dead trees or stands resulting from insect infestations and disease along with fire-killed stands will be harvested thereby

reducing potential fire hazards and improving aesthetic values. The replacement of old growth stands with young growth stands on lands available for timber production will adversely impact those people who enjoy viewing large and aged trees. The appearance of the forest will be further effected by the systematic pattern of trees and other visual evidence caused by such practices as precommercial and commerical thinning. On the other hand, stands made up of well spaced and vigorous young trees will appeal to other elements of the public. Because it is often difficult to locate archeological sites or to recognize some sites, an occasional site may be sometimes destroyed.

2. Air. The burning of 9,000 acres of logging debris each year, principally in northwestern Oregon, will release particulates into the air, however, state air quality standards will be met. The smoke resulting from burning debris will sometimes constitute a minor nuisance to local inhabitants during the fall months. With improving utilization technology it can be reasonably expected that the acreage subjected to prescribed burning will continue on a downward trend during the forthcoming decade. Extensive smoke from any wildfires caused by timber management practices could conceivably result in accidents and deaths.

3. Ecological Interrelationships. Timber management will result in the formulation of man-caused seral stages, formation of new disclimaxes, changes in the cyclic aspects of existing seral stages and the reduction of various species from biologic communities.

Natural catastrophic events will be reduced and replaced in part by man-controlled events. Over time, the present character of the forest will be significantly changed by the replacement of old growth stands (200 years in age and older) with young growth stands. The transition period will be approximately 25 years for western Oregon forests; 40 years for the contiguous U.S. forests; and an undeterminable number of years for interior Alaska based on the current and projected exceedingly low rate of timber harvest.

Consequently, there will be a gradual reduction in the extensiveness of the old growth ecosystem along with its attendant biotic community. While some members of the community may be capable of relocation to old growth stands not subject to cutting or be adaptable to young growth forests, others will be reduced in number or distribution. Although this is a natural phenomenon, since trees and stands die of natural causes, timber harvesting will dramatize and accelerate the process.

Most practices will alter the seral stage or development of a given biologic community. The extent will be in relation to the geography and acreage involved. Species composition and population dynamics along with factors that affect life cycles i.e. reproduction, survival, food chains etc. will be altered.

During the decade, an average of 1.0 to 1.5 percent of the forest in northwestern Oregon will be directly subjected to the unavoidable impacts associated with clearcutting and logging (this percentage will be slightly higher in the remaining contiguous

U.S. forests since partial cutting is the predominant harvesting system employed). Concurrently, the construction of approximately 500 miles of road each year will directly impact 0.1 percent to 0.2 percent of the land annually until the road system is completed some thirty to fifty years hence. These practices along with others will adversely impact ecological interrelationships as a result of soil disturbance and vegetal destruction on individual areas throughout the forest every year. The basic ecological processes relating to nutrients, water and energy will recover within one to five years on most areas due to natural renewable means and in the total forest community a man-nature induced equilibrium will be established and maintained. However, due to human errors and natural phenomena, there will be continuing instances where the ecosystem of small localized areas will be so severely impacted that recovery will not take place within decades from the time the impact occurred.

It can be reasonably assumed that as the degree of program intensity increases, the risk of environmental degradation will also increase, however, improving technology will minimize these risks. Unfortunately, little is known of the combined impacts over time of many practices on forest ecosystems in the United States or even the impact of individual practices on particular forest ecosystems such as those in interior Alaska. Limited knowledge may therefore be the primary reason for the apparent general absence of extensive or significant damage to the ecosystem. However, observations based on centuries of intensive management of European forests along with the experience gained in some southern U.S. forests indicate that intensive timber management is compatiable with the protection, and in some instances, the improvement of the forest environment.

Because of the preponderance of overmature stands in Bureau administered forests, the necessary gradual phasing into an intensive program will provide an opportunity to continually monitor the impacts of timber management practices as their intensity is increased over time and to make whatever adjustments are necessary to preclude any irreparable damage to the forest ecosystem.

4. Recreation. The occasional reduction in the water quality of streams and lakes, primarily in the form of sedimentation, will serve as a detriment mostly to fishermen and secondarily to swimmers and boaters. The occasional invasion of logging debris into waterways will heighten this impact. The risk of toxicants being introduced to waterways as a result of practices employing chemicals will exist and if accidental spillage or drifting does occur, fish populations, and in turn, fishermen will be adversely affected. The "edge effect" created by harvesting practices will provide excellent habitat for many wildlife species while cutover areas will provide increased food supplies. As a result increased populations of game animals such as deer, elk, ruffed grouse and band-tailed pigeons will benefit hunters. The wide variety of flora and fauna resulting from timber harvesting will be beneficial to many birdwatchers and naturalists. Any general recreation use of specific areas will be temporarily disrupted during the period that timber management practices are carried out on the area.

Log truck traffic will represent a hazard to public safety and the accompanying dust will be a nusiance to people on or alongside routes of travel. Conversely, roads built for timber management purposes will provide ready access to many areas of the forest having various recreational values and uses which would otherwise be inaccessible to segments of the public. While these roads will increase the risk of man-caused fires, they will, at the same time, provide better access for the control of fires.

While there are many recreation-type trade-offs the timber management program will be more favorable to the majority of that segment of the public who enjoy the commodity values of the forest such as hunters and fishermen and those who enjoy intensive use as provided by easily accessible camping areas and picnic sites, as opposed to those segments of the public who enjoy the non-commodity values or non-intensive uses such as hikers, natualists and wilderness seekers.

5. Soil. The construction of approximately 500 miles of road per year for the next 30 to 40 years represents the severest impact of any practice on the soil. Although the trend towards more far-reaching logging systems (helicopters, skylines, etc.) will continue, thereby lessening the intensity of the road network. Severe vegetal disturbance in conjunction with earth movement will result in localized soil erosion, compaction and occasional mass slides. Logging practices conducted on about 98,000 acres annually will contribute to a lesser degree to further localized mass wasting, compaction and erosion.

Some leaching of soil nutrients will result from timber management activities, however, these losses will be minimal when compared to the total nutrient reserve of the soil. Although fragile sites whose productivity would be lost due to shallow soils or steepness of slpoe are excluded from cutting, necessary fire control measures such as the construction of fire lines carried out on these areas will result in significant and longlasting adverse impacts on soil stability, particularly in interior Alaska.

6. Vegetation. The natural succession of forest vegetation from pioneer to climax species will be interrupted and in most cases forestalled. Due to the site characteristics of the forests, Douglas-fir will continue to be the predominant species used in reforesting cutover areas, followed by ponderosa and sugar pine. Consequently, climax species such as hemlock and true-firs will be primarily limited to areas which are reforested naturally.

Timber harvesting will increase the diversity of herbaceous and other forms of vegetation following their invasion of cut-over areas. However, cutting along with logging and road constuction practices will result in severe vegetal destruction and disturbance.

The productivity of the forest will increase over time in terms of its predominant biomass, wood, and eventually approach its biological maximum. Possibilities do exist, however, for the dampening of this increase through the removal of organic matter. The reforestation of cutover areas with a limited variety of genetically improved stock could eventually result in stands particularly susceptible to devastation though insect or disease infestations. Furthermore, the continual removal or organic material over centuries through harvesting practices could decrease soil productivity somewhat. Nonethelesss,the risk associated with these potential impacts is low and can be minimized by the use of broad based genetic stock and fertilization practices.

7. Water. Since trees use large quantities of water for transpiration their harvest will increase the amount of water available for streamflow. In general, there will be an increase in peak flows from fall and spring storms but to a lesser degree during heavy mid-winter precipitation, as characterizes western Oregon, since both forested and cut-over areas are saturated at this time.

Surface run-off on disturbed areas, principally on those involving road construction activites, will accelerate to a minor degree the natural rate of eutrophication of water bodies. Occasional mass soil movements will result in above normal sedimentation therby degrading water quality. However, the impact on its currently limited use for human consumption will be minimal in terms of lowered water quality due to the protection afforded by streamside buffer strips.

There will be instances where clearcutting in northwestern Oregon will temporarily raise water temperatures due to increased exposure of small tributary waters to solar radiation. Also logging debris will temporarily reduce the dissolved oxygen content of streams. Nonetheless, with few exceptions, water quality in terms of temperature and oxygen content will remain at non-lethal levels. There will be a risk of serious short term degradation of water quality as a result of potential accidental spills of toxicants, drifting and missed target areas in the course of conducting such practices as chemical weed control and fertilization.

8. Wilderness Experience. The constuction of roads along with most other timber management activities will result in the alteration of natural undeveloped forests which, in turn, will destroy any wilderness type values that are often associated with "virgin" old growth forests. Although there will be old growth forests not available for timber production, their extensiveness will be significantly diminished thereby adversely affecting some elements of the public. The major undeveloped forests which meet formal wilderness area criteria are located in interior Alaska; 99 percent of which will not be subjected to timber management practices based on the projected program for that area during the next decade.

9. Wildlife. The removal or destuction of habitat including nesting and escape cover will result in some displacement or actual loss of wildlife. This sudden impact will be of relatively short duration, however. Such animals as deer, elk, rabbits, grouse, sparrows, thrushes and wrens will respond favorably to the removal of timber and the subsequent increased availability of nutritious brouse, berries, grasses and forbs. Rodents, including ground dwelling squirrels and mice, will increase in numbers due to brush regeneration following logging. Consequently, small predators that prey on these rodents will also benefit. On the other hand, owls, raptors and woodpeckers will be adversly impacted since the number of dead trees which serve as nesting sites, perches or food sources will be reduced in number. Animals

particularly senitive to the presence of human activity, such as cougars, martens and lynx, will be adversely effected in the form of reduced populations as a result of the impact of timber management on their habitat requirements. Displacement of wildlife will result in temporary reductions in populations in those instances where the adjacent lands are at full carrying capacity. The application of chemicals to control brush, grass and weeds will alter the abundance and relative species compostiton of small mammal populations such as pocketgophers and mice.

Eventually, roads will permanently remove 5 percent of the land base from wildlife habitat, encourage harassment of wildlife through ease of vehicular access and reduce the area available to wilderness inhabitating species. In general, however, the "edge effect" created by road constuction and cutting practices along with openings caused by precommercial and commercial thinning will result in a more diverse and productive habitat that, in turn, will produce a greater variety of birds and mammals.

Aquatic habitat and wildlife will be adversely impacted due to sedimentation and slides emanating principally from road construction activities with minimal attendant loss of life. Logging debris will occasionally block streams and dependent upon the time of year temporarily hamper the migration of anadromous fish such as steelhead and salmon. Any accidential spills or drifting of chemical toxicants into waterways can have a severe impact on aquatic life. In general, the accessibility provided by roads to fishermen represents the most significant impact on aquatic wildlife populations.

10. Socio-Economic The annual production of 1.172 billion board feet in western Oregon will continue to represent about 17 percent of the total production of the region and support 13,500 primary timber related jobs and 20,000 secondary jobs (retail trade, service, etc.) These jobs currently represent 8 percent of the total employment in the region but range as high as 35 percent in some local areas. The annual production of approximately 150 million board feet from the remaining forests in the contiguous United States will support some 2,000 primary and secondary jobs while the contribution of interior Alaska forests to employment will be virtually nil. The total annual production of some 1.3 billion board feet will constitute about 3 percent of total U.S. softwood production; the primary products of which will be lumber and plywood to be used in housing construction.

Based on current trends the annual cost of carrying out the program is projected to increase slightly over the 1974 level of $20 million. At the same time, the annual receipts are expected to be in the $150 to $200 million range which are distributed between the U.S. Treasury and applicable State and local government.

11. Summary. The environmental impacts of the program are summarized below in tabular form to provide the reader a capsule view and also a ready comparison with a similar display of impacts shown for the alternative timber management programs in Chapter VIII, Alternatives.

In analysing the following impacts the reader should keep in mind that some individual timber management practices may have a different kind or magnitude of impact on an environmental component than the aggregated impact shown for the program. Also, some elements comprising an environmental component may be impacted in a different manner or magnitude than indicated for the environmental component listed.

Environmental Component	Impact	Magnitude
Aesthetics and Human Interest	Adverse	Major
Air	Adverse	Minor
Ecological Interrelationships	Adverse	Minor
Recreation (General)	Adverse	Minor
Recreation (Fishing)	Adverse	Minor
Recreation (Hunting)	Favorable	Minor
Soils	Adverse	Minor
Vegetation (Health & Vigor)	Favorable	Major
Vegetation (Diversity)	Favorable	Major
Water (Quality)	Adverse	Minor
Water (Yield)	Favorable	Minor
Wilderness Experience	Adverse	Major
Wildlife (Raptors, Large Predators)	Adverse	Minor
Wildlife (Herbivores)	Favorable	Minor
Wildlife (Aquatic)	Adverse	Minor
Socio-Economic	Favorable	Major

B. Environmental Impacts of Timber Management Practices.

Unlike the preceding section this section will totally ignore the mitigative measures identified in Chapter IV in describing adverse and beneficial impacts. This in order to provide the public as well as the Bureau a benchmark for analysis and a perspective of the potential impacts any one action might cause. The unmitigated impacts of all practices are discussed regardless of whether they are included in the program for a particular sub-biome because their potential for application sometime in the future does exist. Any variations in the impacts between sub-biomes will be identified accordingly.

To assist the reader in correlating the impacts of the practices currently planned during this decade with their geographic location and magnitude the table below sets forth the practices or causes of impacts and the acreage to be effected each year. Refer to Section E of Chapter I for a detailed description of each practice. The data relating to logging system acreages are approximations. Generally, western Oregon is located within the Northwest Coastal Forest sub-biome; interior Alaska within the Taiga sub-biome; and the remaining western forests within the Montane Forest sub-biome.

Development Practices	Western Oregon	Alaska	Remaining Forests
Tree improvement	24,000[1]	0	0
Scarification	700	0	300
Mechanical brush cutting	0	0	less than 100
Mechanical trenching-furrowing	0	0	0
Burning	9,000	0	less than 100
Burying	less than 100	0	less than 100
Chipping	0	0	0
Seeding	300	0	50
Planting	23,000	0	2,400
Chemical weed control	5,000	0	100
Baiting	200[2]	0	1,000[2]
Fencing and Screening	0	0	0
Mulching	less than 100	0	less than 100
Snag felling	0	0	0
Fertilization	10,000[3]	0	0
Precommercial thinning	10,000	0	600
Pruning	0	0	0
Stand Conversion	370	0	0
Brush-hardwood control	14,000[4]	0	0
Protection Practices			
Fire Control	-------Total of 275,000[5]-------------		
Insect Control	[6]	0	[6]
Disease Control	[6]	0	[6]
Harvesting Practices			
Commercial Thinning	2,400	0	500
Clearcutting	19,000	0	800
Partial cutting (includes shelter wood, seed tree and selection)	30,000[7]	0	40,000[7]
Mortality slavage	5,500	0	0
Tractor logging	32,000	0	28,500
High-lead logging	16,000	0	4,500
Mobile yarder logging	6,000	0	7,000
Aerial systems	3,000	0	800
Road construction	400 mi.	0	100 mi.
Road maintenace	5,000 mi.	0	500 mi.

1/ Annual acres to be planted with genetically improved stock during 1978-81.
2/ Projects for Fiscal Year 1975 only.
3/ Operational test for Fiscal Year 1975.
4/ Scheduled for Fiscal Year 1975; reduced to some 5000 acres annually thereafter.
5/ Based on historical average 1969-1973. Approximately 95 percent of the 275,000 acres will be in interior Alaska.
6/ Carried out through normal cutting practices.
7/ Shelterwood cutting is predominant practice.

1. Ecological Interrelationships. The nature of many chain-like relationships in the cycles and flows that link the components of the ecosystem are not known or understood. It can be assumed that impacts on one part of the ecosystem will effect the whole, however, the manner and magnitude in which the total ecosystem is affected is often unknown or vague at best. Some information does exist, however, for impacts of specific practices for particular locations on parts of the ecosystem which may be indicative of the impact of the same or similar practices conducted in other locations.

While atypical of timber management practices, an experiment in New Hampshire in 1965 which involved the cutting of all vegetation, leaving the debris and then chemically killing all resprouting vegetation for 3 years, reduced the nutrient capital of a forest ecosystem by; (1) increasing the amount of water passing through the system, (2) by reducing root surfaces able to remove nutrients from the leaching waters, (3) by the removal of nutrients in wood products, (4) by adding to the organic matter available for immediate mineralization, and (5) in some instances by producing a microclimate more favorable to rapid mineralization. Later results from the study indicate that as soon as the chemical treatments were stopped, nutrient losses returned rapidly toward their former state before devastation of the area and chemical treatment began. A more typical example of timber management practices was a study made in western Oregon in the 1960's which examined the impact of scattered clearcuts (with streamside buffer strips) in one drainage and a large clearcut extending across a stream in another drainage. No changes were observed in the nitrate nitrogen, potassium, and phosphorous content in stream water in the scattered clearcut drainage and a four-fold increase in nitrate nitrogen loss in the large clearcut following logging and burning. The study concluded this amount of loss posed no threat to forest soil productivity in the study area since the soil contained high nitrogen capital due to its capacity for holding and storing nutrients and that rapid revegetation limited future nutrient loss by quickly reestablishing the cycling process. However, the study also concluded that the micro-organism with cutthroat trout populations of the stream in the clearcut drainage were adversely affected, thereby disrupting the ecological interrelationships of the aquatic ecosystem.

The application of the results from these and other studies must be interpreted with respect to the practices employed and the specific conditions that characterize the impacted area. These include soil, topography, climate, vegetation, the design of the cutting areas(s) and the method of logging. It may be safely assumed, however, that the application of any timber management practice that completely destroys terrestrial and aquatic vegetation will have a severe short term impact on the ecological interrelationships of the impacted area. This is based on the fact, if nothing else, of having removed the sole producing component of the ecosystem upon which all other members of the biotic community depend, either directly or indirectly. Any resulting reductions in population densities of the living components of the community due to mortality or relocation may only be temporary, nonetheless the ecological interrelationships of the impacted area and possibly offsite areas are disrupted. If the ecological interrelationships in adjacent undisturbed areas are in delicate balance, the relocation of such animals as deer, elk, etc., may further extend the impact of the action. Therefore, the severity of the short term impact is not always localized to the directly affected area but is dependent on the ability of adjacent areas to absorb increased animal populations, in this example, which in turn is partly a function of the nature and magnitude of the action itself. While the physical impact of timber management practices on vegetation are readily visible, impacts on the micro-organisms in the soil that act as decomposers are indiscernible and perhaps more subtle. Nonetheless, they constitute a vital link in the trophic hierarchy and their elimination or reduction due to chemicals or severe soil disturbance practices can also result in significant adverse short-term impacts on the ecosystem.

The long term impact of most practices on the ecosystem is primarily dependent upon the rate of recovery of the area affected which varies with its physical and biotic characteristics. Generally, communities with high productivity in terms of the vegetal biomass can recover relatively rapidly. Communities with low productivity, i.e., plants with low growth rates and animals with low production rates, are generally fragile and slow to recover.[3] Consequently, the long term impacts of any of the development, protection, harvest and transportation practices that remove vegetation and/or cause extensive surface disturbance can be particularly severe in the Taiga Forest and the sub-alpine and alpine zones of the Montane Forest. Other localized areas within the Montane and also in the Northwest Coastal are fragile and highly susceptible to severe impacts on the ecosystem if disturbed. Regardless of the sub-biome involved, harvesting practices conducted in overmature stands will diminish the extensiveness of the old growth ecosystem with its unique biotic community, either immediately as in the case of clearcutting or over time in the case of other final harvest practices. While opportunities do exist for the relocation of some members of the community, certain species will not be mobile or adaptable, resulting in reduction in total populations of these species.

Relative to the potential impact of the biotic components of the ecosystem, the impact of timber management practices on the atmospheric components of the physical environment are considerably less. Although burning practices do release some chemical toxicants into the air, their impact is minimal in terms of human health and appear to have no impact on the ecological relationships within the forest environment.

Even though the impact of any one practice on any one area is severe, its significance will probably be greatly diluted when viewed in the context of the size of the impacted area in relationship to the size of the surrounding geographic area. Nonetheless, many practices are conducted in different parts of the forest at the same time, and in total can cause a severe impact to the ecosystem of the general area. In conjunction with this, timber management actions on adjacent Federal, State or private lands will contribute to the cumulative impact of timber management practices within a given drainage or area. Using a time dimension, individual practices, including those having little adverse impact, continuously carried out over time can have a significant cumulative adverse impact on the ecosystem at some point in the future.

2. Impact on Physiography, Geology and Minerals

The impacts can be divided into those actions which affect (1) the minerals, and (2) the landforms or topography. In general, timber management practices have little or no impact on minerals; therefore, this subject of minor significance will not be pursued further, herein.

Certain timber management practices do, however, affect the landform or topography by increasing the weathering potential and rate of erosion, thus increasing the likelihood of landslides including rock creep, soil creep, solifluction, earth flows, mud flows, sheet wash and other related phenomena. Three principal factors cause these landslide phenomena: (1) the topography, (2) the geologic structure, and (3) soil characteristics. In short, any geological structure or soil rock condition which permits complete saturation by ground water to lubricate the mass and reduce internal friction to a minimum favors landslide development.

Forest Development

Scarification, mechanical brush cutting, trenching, and furrowing and area burning increase soil erosion, especially during the wet season, by exposing the surface to the effects of raindrop splash, gullying, and headward erosion. Saturation of the soil and the underlying rocks could result in landsliding if the geologic structure and rock types are conducive to sliding. The effects of spot burning are similar to area burning but to a lesser degree because a smaller part of the surface is exposed to weathering. Burying slash increases the porosity and permeability of the ground surface exposing it to the effects of moisture during the wet season. Localized wet spots can develop and slumping might occur on over-steepened slopes. Chipping provides a surface cover of litter which reduces the impact of raindrop splash thus reducing its erosive potential.

Hand clearing and cleaning reduces surface cover exposing the soil and rocks to moisture and other erosive elements resulting in landslides if the geologic structure and rock types are so conducive. Chemical control measures remove vegetation that provide surface cover and hold the soil blanket together and unless replaced by another more desirable plant would have the effect of increasing erosion. Snag felling, precommercial thinning and pruning have little or no effect on erosive processes.

Protection

Fire lines constructed by tractors expose the surface to erosion and are particularly harmful in the Taiga Forest. The sidecast increases the potential of mass wasting when deposited in drainages or along steep slopes. Back firing has the same impact as area burning, described previously.

Cutting Practices

Those practices such as clearcutting and shelterwood cutting which remove a higher percentage of the forest cover increase the erosion potential by exposing the surface to the effects of moisture. Steep slopes, which have soil rock types and a geologic structure conducive to slope failure when saturated by moisture, are more prone to landslide and related phenomena when the herbaceous cover is removed.

Logging Method

Ground logging systems have an adverse impact, the magnitude of which is dependent upon the soil topography, rock types, geologic structure, climate and the type of equipment used. Erosion in the form of raindrop splash, gullying and headward erosion increases when the surface layer of soil and forest litter is disturbed along with the removal of the foliage canopy. Sidecasting and landing construction on steep slopes or in drainages initiates sliding if the materials become saturated. The unmitigated impacts of logging methods upon the surface are a precursor to the impacts which might occur due to the geologic situation and are discussed under Soils.

Transportation

The impacts of road construction on slopes can be divided into two categories: (1) those problems associated with slopes in soils and (2) those associated with slopes in rocks. The basic factors affecting slopes in soil or rock are similar, although rock strengths are orders of magnitude greater than soil strengths. In general the strength of large masses of soil depends upon the cohesion, and resistance to tensile and shear stress; the strength of large masses of rock depends upon the strength of the rock and the defects, such as faults, fractures, or joints, that intersect the rock. The stability of a soil or rock slope is presumed to be a function of the slope height, slope angle, the size of the excavation and the stresses imposed on the soil or rock by tectonic and/or gravity forces, earthquakes, or other static or dynamic forces. Also slopes are affected by static and dynamic water pressures in the pores of soils or permeable rocks. These are all natural forces affecting slope stability. The introduction of man and his construction of roads and other excavations upsets this balance in the stability of many slopes. Clearing the vegetative cover exposes the surface to erosion and the effects of moisture. Excavation removes former support. Filling and embankments often over-steepened slopes and increase slide potential. Drainage patterns can be upset and increase the erosive potential. The impacts of maintenance practices are neligible.

3. Impact on Soils

Forest Development

Scarification of approximately 1,000 acres annually disturbs the protective litter layer and churns up the topsoil thereby exposing it to raindrop, splash erosion and subsequent soil creep. Compaction of the soil, which reduces productivity, will result if scarification is done during periods of soil wetness. Mechanical brush cutting of less than 100 acres annually will result in soil compaction from the equipment when the soils are wet, however, the cut brush will add to the soil cover and hasten the natural nutrient cycling in the soil. Mechanical trenching-furrowing will expose the soil and act like a road for erosion, mass wasting, and loss of productivity. Area burning of approximately 9,000 acres annually will cause a loss in plant nutrients from the soil since nitrogen, sulphur, and about 30 percent of the phosphorous are lost during burning. Burning the organic matter also creates a non-wettable soil surface condition, especially under dry conditions on coarse textured soils causing surface water runoff, hence erosion. Spot burning intensifies the conditions outlined under area burning, sometimes to the point of soil sterility which lasts for a number of years. Where permafrost exists it could melt and initiae a new sequence of erosion. Burying slash on approximately 200 acres annually causes soils to be exposed to erosive agents when the litter is removed. The wasted soil will also ravel or creep downhill if slope gradients in excess of 30 to 45 percent are involved. Chipping slash and spreading it back over the land will give additional litter cover, causing a temporary reduction in available soil nitrogen, and hasten the natural nutrient cycle. Chipper and equipment will cause soil compaction. Hand clearing and cleaning will expose the soil to the erosive elements, accelerate erosion, and temporarily disrupt the nutrient cycle. Seeding and planting of approximately 25,700 acres annually will protect the soils from erosion, however, mechanical planting will cause some compaction and expose soil for erosion for a short time. Mulching of less than 200 acres annually of the soil surface protects it from erosion but may suppress natural growth which provides a natural watershed cover. Fertilization of 10,000 acres in fiscal year 1975 with the proper amounts of nutrients will promote additional vegetative growth which in turn provides better cover against soil erosion. Any gas or chemical spills could cause temporary soil sterility during precommercial thinning operations.

Protection

The use of insecticides and fungicides can cause an imbalance of the soils macro fauna and fungi for an unknown period of time, however, the full impact of this shift in balance is not known. The degree of the shift would depend upon the quantity applied, depth of penetration and length of time before decomposition. These factors are quite variable depending upon rate of application, types of chemicals used, and climate. The use of retardants to suppress fires is not detrimental unless there is a high proportion of elements such as boron. Tractor constructed fire lines expose the soil to erosion forces and where lines run up and down the slope serious erosion will result. Tractor constructed fire lines are particularly harmful in the Taiga Forest. Materials cast aside into draws can increase the potential for mass wasting. The impact of backfiring is similar to area burning described under Development.

Cutting Practices

Clearcutting of approximately 20,000 acres annually will expose the soil to erosive forces, particularly water, and increase the potential of landslides on non-cohesive soils. Since most of the vegetative cover is left intact on the 89,000 acres annually subjected to precommercial and commercial thinning, shelterwood and selection cutting and mortality salvage, minimal soil exposure will result.

Logging Methods

The unmitigated effects of logging methods upon the soil are interrelated functions of types of soils, equipment, weather, and topography. For example, soil may be severely damaged by crawler tractor logging on approximately 60,000 acres annually during times of soil wetness but the same soils may not be harmed if the same operation is conducted when the soil is frozen and protected by snow cover. The hazard for soil sterilization in small areas from fuel or oil dumping and spills is always present when motorized equipment is employed.

Logging methods with the least impact upon the soil are standing skyline, running skyline, slackline, balloon, and helicopter yarding since they require the least amount of roads and trails and cause the least amount of litter and soil disturbance during yarding. These methods will be applied to approximately 3,000 acres in western Oregon and 800 acres in the remaining contiguous States annually. Road and landing construction can initiate soil erosion and sometimes landslides.

Logging methods with a moderate impact upon the soil are horse skidding, high-lead yarding, and mobile yarder-loader operations. These methods which will be applied to approximately 22,000 acres in western Oregon and 12,000 acres in the remaining contiguous States annually, require more roads and landings than methods listed above and also disturb a larger percentage of the litter layer and topsoil. Trails where the logs are skidded or yarded become scraped and compacted. These two conditions concentrate water and provide areas for overland flow of water causing rill and gully erosion.

Logging methods which have a severe impact upon the soil are the crawler tractor, rubber tired skidder and jammer yarding. These methods will be employed on approximately 32,000 acres in western Oregon and 28,000 acres in the remaining contiguous States annually. Tractor logging disturbs and compacts as much as 40 percent of the area. The main skid roads receive the severest damage and occupy about 20 percent of the area. Soil structure is usually destroyed on frequently traversed areas and is more easily destroyed if the soils are wet. Surface runoff is the rule under these conditions. In comparison, tractor logging causes deep soil disturbance over 15 percent of the area while moving cable logging causes

2 percent. Jammer yarding requires a dense road network and results in more area being exposed to erosive forces than any other logging method. Logging methods that disturb the surface serve a useful purpose by removing layers of organic material and exposing mineral soil for seed germination.

Transportation

Road construction of 500 miles annually has the greatest impact on soils of all timber management practices. Construction site operations create erosion and sedimentation problems mainly during the period between land clearing, shaping, and stabilization of the new soil surface. The release sediment may have a lasting effect on the channel shape of a stream as well as affecting the construction project and water environment downstream. The impact of construction operations upon the soil are interrelated functions of types of soils, equipment, weather, and topography. Clearing and grubbing opens up an area and removes the vegetation and disturbs and exposes the soil to erosive elements. It can cause soil compaction particularly on wet soils, accelerated erosion and disrupts the nutrient cycle. The excavation of earth or rock from its natural resting place has several impacts on the soil resource by: (1) altering the natural drainage from hillsides and exposing underlying soils to weathering action, (2) removing lateral support to adjacent material and, (3) unloading a slope at a critical point thus triggering landslides. Blasting in rock excavation compacts, shakes and fractures the soil resource resulting in erosion. Embankments consisting of man-made deposits of soil may affect the soil resource by a combination of equipment and soil placement operations, particularly during wet weather. Fills add weight to the underlying soil mass, which on steep hillsides can trigger landslides or slip failure. Added weight of fills on faulty foundations can result in slumps and settlements. Newly constructed fills have bare slopes which contribute to erosion and sediment until stabilized and, when placed at an angle greater than the normal angle of repose, are prone to failures. Grading operations impact soil by cutting, smoothing and disturbing surface materials on road surfaces, fill slopes, cut slopes, ditches and other areas requiring shaping. Wet weather during these operations can cause erosion and sedimentation.

Seeding and mulching equipment used in stabilization efforts during wet soil conditions may rut and disturb the soil causing erosion and sedimentation problems. Topsoiling and seed bed preparation by tillage and discing loosens and disturbs the soil so that it may be easily eroded prior to turf establishment. Time of seeding operations may result in lack of seed germination; thereby leaving bare slopes exposed to soil erosion. Shoulders, fill slopes, slopes of ditches, drainageways, areas around drainage structures, cut slopes, and other areas outside the rounded tops of cuts and toes of fills are possible sources of erosion.

Quarrying impacts the soil resource by exposing underlying materials to weathering. Explosives used in this material removal operation fracture, shake and disturb the soil resource causing the loosened soil and overburden material to be susceptible to erosion. Road bases distribute the load to the underlying soils and road surfaces and prevent infiltration of water into the base. The impervious surface creates a watershed which impacts the exposed shoulders and fill slopes and causes soil erosion and sedimentation of streams. Use of excessive oil application on an area and oil spillage during surfacing operations may contaminate soil and water.

Roadside ditches, which carry large amounts of water for long distances particularly on steep gradients, may cause ditch and fill slope erosion. This may result in the clogging of ditches and drainage structures thereby endangering the stability of side slopes in embankments and cut sections. Accelerated erosion of ditches may be caused by excessive water velocities on easily eroded soils. Construction of bridge and culvert structures can affect stream sedimentation through equipment disturbing the streambed and stream banks and by pushing loose material (logs, branches, and soil) into the stream during site preparation and construction. Bridge and Culvert approach fills, banks, bedding and backfill material can be ready sources of soil erosion material and also constrict natural waterways, thereby increasing the velocity of water which may cause scour and soil erosion. Culverts not properly oriented with natural stream channels and without proper inlet protection, gradient, outlet control or proper outlet discharge may cause bank erosion and scour holes at culvert outlets, resulting in soil erosion and stream sedimentation.

Under maintenance improper surface repairs of dirt, gravel and bituminous surfaces contribute to sedimentation and soil erosion by material loss, poor drainage, pot holing, stripping and rutting surface irregularities. Spillage of petroleum products or excess application may result in soil contamination. Materials removed from plugged culverts and ditches will contribute to soil erosion and sediment problems if placed in unstable locations.

Equipment working the stream to repair structures causes disturbance of the streambed and banks. Soil dumped in flow water in the course of repairing banks, piers, abutments and approach fills cause soil stream sedimentation. Improper actions in debris and slide removal and disposal make them prime sources of material for soil erosion and stream sedimentation. Waste soil may ravel or creep downhill if steep slope gradients are involved. Chemical brush control is not usually detrimental to the soil. Mechanical brush cutting adds to the soil cover and speeds up the natural nutrient cycling in the soil, however, the equipment used can cause some soil compaction.

4. Impact on Water

Forest Development

Area burning of approximately 9,000 acres annually exposes mineral soil to precipitation that can result in surface erosion or mass wasting which, in turn, may cause sedimentation of forest streams. Severe burning can significantly increase sediment yields, especially on steep slopes in areas of heavy participation.[8] Sediment concentrations after hard burning may be many times greater than those observed on an undisturbed watershed and persist for several years after burning, steadily declining as the exposed mineral soil becomes revegetated.[9, 10] Observations made so far relative to nitrate concentrations in streams following burning would indicate that these concentrations will be far less than the limit of 10 parts per million recommended for domestic use, and well below any level deemed harmful to aquatic life.[11] However, on one study area, a surge of nutrients in streams, following area burning, contained concentrations of ammonia and manganese that exceeded Federal water quality standards for a period of 12 days.[12] Area burning can also cause significant increases in stream temperatures. Hot slash fires reduce or eliminate streamside shade, with resulting exposure to direct solar radiation which can cause increases of at least 14°F. in mean-monthly maximum stream temperatures. These temperature increases may be critical to the aquatic ecosystem and survival of the life it supports.[13] The effects of area burning on ground water are less well documented. However, it is known that high fire temperatures at the soil surface reduce water infiltration rates by producing a non-wettable (water resistant) layer of soil beneath the ash-dust surface and the mineral soil immediately under the surface.[14, 15] The water-repellent layer lies parallel to the soil surface and may vary in thickness from 2 to 4 inches.[15] The presence of this barrier means that only a thin surface soil layer is available to store and transmit water during a rainstorm. Consequently, even in relatively light showers the surface layer quickly becomes saturated, producing excessive surface runoff and erosion and, of course, stream sedimentation.[16] Although no known research has been conducted on the effects of such reduced infiltration, it seems logical that if the impermeable layer is extensive in area the groundwater table could be significantly affected. So far as is known, area burning has not been employed as a slash disposal measure in the Taiga Sub-biome. However, the effects of a hot slash fire on water quality would be similar to those of a wildfire. A recent study of the effects of forest fires in interior Alaska indicates that significant impacts are of three kinds:[17]

- There is an increase in chemical oxygen demand concentration in streams in the burned area, resulting from the presence of organic material transported from the burned site to the stream systems by increased erosion.
- Potassium concentrations are higher in streams draining burned areas that in streams draining unburned areas.
- Suspended sediment increases were observed in streams during periods of high runoff immediately following the fire, which occurred in August and September. This appeared to originate from the erosion of fire trails. However, the increased sedimentation was of relatively short duration.

Even though there was no statistical evidence during the sampling period that the fire had caused significant changes in the biota of the streams, there were some indications that there may have been some effects on aquatic organisms during and immediately following the fire. It can be expected that burning will increase the amount of nutrients available to aquatic biota. Such increases can alter plankton cycles and increase or decrease plankton blooms.

The indiscriminate use of heavy equipment in scarification can cause sedimentation and turbidity of lakes and streams. The magnitude of this water quality degradation will vary directly with slope, amount of precipitation, instability of the soil mantle, and area and depth of soil disturbance.

The use of chemicals in baiting, treated seed, animal repellants and weed control on some 6,300 acres annually also has potential for degradation of water quality. Knowledge is lacking regarding the long-range effects of these substances on our water resources. The biological significance of trace amounts of many of the complex carbon compounds is only partially understood, their persistence in natural waters largely unknown.[18]

The use of toxicant and repellent chemicals to protect seedlings from rodents and browsing mammals is limited to ground applications in forest nurseries and seed orchards. Under these controlled conditions, these chemicals pose no threat to water quality.

In aerial application of chemical sprays used in weed and brush and hardwood control (14,000 acres in western Oregon in fiscal year 1975 and approximately 5,000 acres annually thereafter) possible entry routes of chemicals into surface waters may not be recognized. Large amounts of herbicides may enter water in a short time when streams and lakes are included in treatment areas. Significant amounts of aerially-applied herbicides may not reach the target area intended for treatment because of lateral drift due to air movement or interception by the forest canopy.[19] Only small amounts of intercepted herbicide will enter the aquatic environment due to the washing action on the forest canopy.[20] Likewise, sub-surface flow or leaching of herbicides through the soil profile to groundwater and finally to surface waters is a slow process capable of moving only small amounts of chemical relatively short distances.[19] This finding indicates that the impact of herbicides on the quality of groundwater is slight. However, surface flow or runoff can move large amounts of chemicals a long distance in a short time. Chemicals moving in surface flow need not be in solution but may be absorbed on soil particles. Sheet erosion of soil from areas treated with herbicides is a serious threat to the quality of the aquatic environment. Steep slopes, reduced ground cover, and compacted soils encourage surface flow of water and movement of herbicide residues.[19]

Concentrations of herbicides exceeding 0.1 ppm will seldom be encountered in waters adjacent to carefully controlled forest spray operations.[21] These concentrations are well within acceptable limits, however, they could have adverse impacts on aquatic biota not presently known to man. Concentrations exceeding 1 ppm have never been observed and are not expected to occur, although there remains the possibility of accidental spills,[22] chronic entry of herbicides into streams for long periods after application does not occur. There remains for consideration the possibility of contamination of water by diesel oil, one of the principal carrying agents used with forest herbicides. A comprehensive review of pertinent research literature has indicated that petroleum carriers, carefully applied, present no significant threat to the quality of surface water or groundwater. One researcher found that most danger lies in careless handling of oil containers and unused oil, and in field cleaning of spray equipment.[23]

Forest fertilization of 10,000 acres in western Oregon in fiscal year 1975 involves the aerial distribution of chemicals to promote tree growth. The nitrogen is usually applied as large, specially coated urea granules (forest prills). These granules are relatively heavy and have eliminated the problems of lateral drift and foliar interception experienced in the aerial application of herbicides.[24] Thus, control of nitrogen application is relatively good; nearly all of the fertilizer reaches the target area. The greatest potential route of fertilizer nitrogen entry into the aquatic ecosystem is by direct application to exposed surface water in the area treated. Overland flow is also a major factor in areas where surface runoff commonly occurs. Subsurface drainage of dissolved nitrogen also moves the fertilizer into streams. Despite the filtering effects of forest soils, measurable levels of nitrogen compounds have been found in streams monitored for water quality.[24] In several studies of the effects of forest fertilization on water quality, maximum standards set by the U.S. Public Health Service were not closely approached, even during the short-lived peak concentrations.[25, 26] While testing of the effects of fertilization on forest waters has revealed no serious adverse impacts to date, knowledge in this area of research is incomplete.

In the Taiga Sub-biome there have been no applications of the chemicals used in forest development and protection (except for use of fire retardants), and no chemical applications are planned for the foreseeable future. The impacts of these chemicals on the water resources of the Taiga generally would be similar to the effects noted by research elsewhere in the Coniferous Forest Biome. However, climatic and soil peculiar to the Taiga might modify these effects significantly. For example, the long duration of freezing temperatures, short growing season, permafrost and slow drainage might greatly prolong the residual effects of some chemicals.

Protection

The use of chemicals in forest protection involves applications of insecticides, fungicides and fire retardants. Fungicides are applied in seed orchards by readily controlled ground methods, without hazard of damage to water resources. Insecticides applied by aerial methods can enter forest waters by the same routes followed by the herbicides used in development treatments. The principal routes of entry are direct application or drift of spray materials to the water surface, and overland flow of insecticides in surface runoff.[20] Conditions favoring the contamination of the aquatic ecosystem by insecticides are the same as those which favor the entry of herbicides. However, insecticides in general are less mobile in solid than herbicides.[27] The toxicity and persistence of chemicals used as forest insecticides is variable. The chlorinated hydrocarbons (DDT, dieldrin, chlordane, etc.) are not usually toxic to mammals in the concentrations normally encountered but fish and aquatic organisms may be highly susceptible. These compounds are especially resistant to degradation to non-toxic end products and may persist in the soil for months or years following application. Most of them are only slightly soluable in water.[28] Daily ingestion of sub-lethal doses of DDT may be accumulative and fatal to mammals.[29] Its extremely adverse effect upon the reproduction of birds is well known.[30] The organophosphorus insecticides (parathion, malathion, ect.) are highly variable to toxicity to different species of similar organisms.[31] Parathion can be highly toxic to mammals, with noticeable effects on humans possible from a water supply contaminated by spray treatment.[32] The toxicity of malathion to warm blooded animals is estimated to be only 1 percent that of parathion.[33] The residues of some of these compounds disappear quickly, but the persistence of dangerous amounts of parathion in soil has been documented.[32] Pyrethrum does not appear to be significantly toxic to most life forms.[34] It does not persist in the environment and the possibility of its movement from soil to streams is slight.[35]

Several chemical fire retardants containing ammonium or phosphate compounds are widely used to suppress and control forest fires.[36] Some retardants are applied by ground units or helicopters, by which maximum control and utilization on the target area can be achieved. Aerially applied retardants may enter waterways or lakes directly or by movement in surface runoff. The major known effect of these chemicals on the environment appears to be their impact on water quality and on fish and other aquatic life. There have been some documented kills of fish caused by field applications of retardants.[37] Laboratory tests have established that four commonly-used retardants are toxic to juvenile salmonids at concentrations which could occur in natural waters as a result of field applications. Those retardants with higher percentages of potential ammonia appear to have the more lethal effects on fish; the phosphate-based retardants seem to be less lethal.[38, 39] Although research so far completed has focused on the effects of retardant chemicals on fish, it is probably that they also have significant impacts on the quality of water for domestic use and watering of livestock and terrestrial wildlife. The colloidal material (clays, etc.) used as carriers with these compounds are chemically harmless but could cause turbidity in surface waters. Retardant applications may have significant adverse effects on the valuable fishery and terrestrial wildlife resources of the Taiga Sub-biome.

Fire line construction can cause sedimentation and turbidity of surface water by the exposure of the mineral soil to the impact of rainfall and surface runoff resulting in erosion and soil movement into streams and lakes. The effect increases with slope, amount of precipitation, instability of the soil mantle, and area of surface disturbance. Building fire line by tractor disturbs much more surface area than does line building by hand-trailing, and is thus more destructive under comparable conditions.

In the Taiga Sub-biome, on soils underlaid by permafrost, tractor-built fire line can be particularly damaging to the aquatic environment. A study of the Taiga indicated that tractor-built fire lines contributed high sediment loads to streams. A major contributing factor to the erosion of fire lines was the melting of permafrost caused by removing the organic layer. The researchers conclude that fire control measures may cause more serious long term damage to the aquatic ecosystem of the Taiga than the fire itself. Back firing can have the same impact as area burning as described previously.

Cutting Practices

Clearcutting of approximately 20,000 acres annually, and to a lesser extent seed-tree cutting, cause removal of forest cover which exposes natural water surfaces to continuous, direct solar radiation. When the forest cover is removed, direct solar radiation provides much of the energy required to raise water temperature.[40] The slash and brush remaining after removal of timber may provide shade to maintain water temperatures at relatively low levels, however, elimination of this shade by burning exposes the water surface to direct solar radiation.[18] An increase in maximum stream temperatures from about 50°F. before clearcutting and burning to about 85°F. afterward has been observed.[10] Increases in water temperature favor the growth of pathogens or various plankton and vegetation and reduce the supply of dissolved oxygen, with adverse effects on aquatic life. Water temperature increases can also cause fish mortality.[10] Clearcutting on steep slopes in areas of shallow soils and heavy precipitation can cause, after several years, mass soil movement, resulting in sedimentation and degradation of water quality. This delayed impact is caused by deterioration of the root systems of the trees removed.[41] Considerable logging debris may be deposited in natural waters as a result of clearcutting. This organic material contains simple sugars which are released by leaching and used as food by aquatic micro-orgamisms. In the process, these organisms extract oxygen, thus reducing the dissolved oxygen content of the water to levels which may be lethal to aquatic life.[42] Slash and other logging debris may dam streams, slowing velocity and reducing turbulence. As a result, the inadequate supply of dissolved oxygen may not be replenished.[43] The direct evidence of such water quality degradation is the growth of bacterial slimes and algae which thrive on the nutrients released by organic decomposition.[42] Clearcutting and other timber harvesting methods can be beneficial in increasing the supply of water available for human use. Considerable research shows the potential of various cutting practices, properly applied to increase water yields from forested watersheds significantly.[44-47] Man-made openings in the forest canopy can cause the following effects:

- increased accumulation of snow in openings;
- reduction of precipitation losses due to interception by the forest canopy and evaporation therefrom;
- reduction of soil moisture losses caused by transpiration of vegetative cover;

all of which result in increased runoff and more available water.

In the Taiga Sub-biome, any cutting practice which creates large openings in the forest canopy could have adverse impacts on water quality

The greatest effects would be associated with clearcutting on areas underlaid by permafrost. Here, exposure to direct solar radiation could cause sub-surface thawing and surface runoff from skid trails, thus increasing sedimentation and turbidity in surface waters.

The precommercial and commercial thinning, shelterwood and selection cutting, and mortality salvage of approximately 89,000 acres annually will have minimal impacts on water quality due to limited soil and vegetative cover disturbance.

Logging Methods

Falling and bucking of timber causes no degradation of water quality unless trees are felled into or across surface waters at which time the lopping of limbs and the cutting of logs may deposit slash and organic debris in the water. This can cause the reduction of dissolved oxygen and adversely impact aquatic life. All of the ground skidding and yarding methods carried out on about 94,000 acres annually have potential for significant adverse impacts on water quality, since all cause some degree of soil disturbance. The effect is most pronounced when clearcuttings are logged by tractor, particularly on slopes of 15 percent or more and on saturated soils.[48] The resulting disturbance exposes mineral soil to surface erosion, with consequent sedimentation and turbidity of surface waters caused by materials carried downslope in runoff. Sedimentation would have a particularly significant adverse impact on municipal watersheds in western Oregon. The relatively short reach of the jammer makes a dense network of parallel roads necessary for effective operations. If the road system already exists, the jammer can be used without much soil disturbance. If new roads must be constructed to support the jammer operation considerable soil will be disturbed, probably with severe impact on surface water quality.

Logs yarded across streams, or skidded down stream channels by tractor logging on approximately 60,000 acres annually increase stream sedimentation and turbidity. When heavy equipment enters a stream during stream clearance operations stream sedimentation and turbidity are increased temporarily and there is the added risk of water contamination by grease, oil and diesel fuel. Servicing and fueling of logging equipment and log trucks on forest lands adjacent to streams or lakes also can pollute water with petroleum products. In areas of steep terrain the excavation of landings will expose quantities of mineral soil to the impact of rainfall, with resulting ravelling of embankments and downslope movement of sediments with surface runoff into natural waters. The logging of approximately 4,000 acres by use of aerial systems will have little affect on water quality due to the suspended nature of the logs yarded.

Logging operations could have severe impacts upon the fragile aquatic ecosystems of the Taiga Sub-biome, particularly on areas underlaid by permafrost. Ground skidding and yarding on these sites could cause accelerated subsurface thawing and surface runoff from skid trails, with resulting increased sedimentation and turbidity in surface waters.

Transportation

All of the activities connected with the construction of about 500 miles of road annually which involve surface disturbance or movement of earth and rock can cause degradation of water quality. These activities include clearing and grubbing, excavation and embankment, installation of culverts, quarrying and grading. The adverse effects are greatest when midslope roads are constructed by excavation of a "bench" and excavated material is wasted by sidecasting. The excavated materials may be carried downslope into watercourses immediately by gravity or later by surface erosion or sliding and sloughing. Excavation for midslope roads sometimes removes material which supports unstable soils further upslope, with the result that the unstable soil mantle may later move downslope as a mass, sometimes damming a stream. Studies have shown that road construction associated with logging, rather than logging itself, is the factor which causes greatest surface erosion and mass soil movement, with resulting degradation of water quality.[9, 49] Construction of drainage ditches and bridges and installation of gabions, etc., in stream channels can cause short term turbidity of streams while the work is being done. Contamination of water by grease, oil and diesel fuel may also occur, if machinery used in these operations enters the water. Improperly installed culverts may discharge surface runoff onto fill slopes, eroding these slopes and carrying sediment into streams or lakes.[52] The use of petroleum products (oils and asphalt) in road surfacing and surface maintenance can contaminate surface waters. So can the application of herbicides for roadside brush control.[50, 51] These materials may enter water as a result of careless handling or application, or use of excessive amounts, either directly or by movement in surface runoff. Oils and diesel fuels spilled when road construction equipment is fueled or serviced may also enter streams or lakes.

In the Taiga Sub-biome, road construction and associated actions could cause very significant degradation of water quality. Removal of the insulating organic layer from the surface of areas underlaid by permafrost would cause accelerated subsurface thawing, which would probably result in considerable surface runoff and consequent increases in stream sedimentation and turbidity. Some contamination of surface waters by petroleum products would be almost inevitable.

5. Impact on Air and Microclimate

Forest regions are products of the general climate of the earth, over which man has no real control. However, to the extent that may can destroy or conserve forests, he does control some climatic factors locally, even though he does not affect the general climate over large regions. Viewed in this light, the forests of the Coniferous Forest Biome assume much greater social significance than they would have as an economic resource.[53] Nevertheless, the general climate affects forests to a much greater extent than man's activities influence climate. There is an interaction; forest conditions controlled by man affect climate locally, but general climate affects forest conditions both locally and over vast areas.[54] The climate in which a given tree or stand lives may be entirely different from the regional macro-climate. Man's activities can alter the micro-climate.[55]

Forest Development

Area burning and spot burning on approximately 9,000 acres annually like wildfire, creates smoke, which is regarded in varying degrees as an air pollutant. Much of the organic matter in smoke from forest fuels is similar to material naturally entering the atmosphere from living vegetation or from the decomposition of vegetative material.[56] Research indicates that toxic compounds released into the air by burning forest fuels are negligible.[57,58] There is no evidence that the combustion products of slash burning cause permanent injury to human health.[59] The corollary conclusion is that area burning and spot burning have no significant adverse impact upon air quality standards.

Area burning can, however, modify or change the micro-climate. An area burn can consume organic duff, slash and brush thus exposing the mineral soil. In some ecosystems, the resulting climatic reaction may be favorable to the regeneration of trees.[60,61] In others, lethal soil surface temperatures or deficient moisture may inhibit the establishment of tree seedlings and favor invasion by brush.[62,63] In the Rocky Mountains at the lower edge of the Coniferous Forest Zone, fire may so modify the local climate through destruction of cover and exposure of surface soil that plant succession may end with colonization by grasses or desert shrubs characteristic of the next lower vegetational zone. At the higher elevations well within the coniferous forest, succession after fire will normally lead to eventual replacement of the coniferous forest itself.[64] A recent study of white spruce regeneration in the Taiga Sub-biome indicates that, on mineral soils not underlaid with permafrost near the surface, this species may be successfully harvested and regenerated by clearcutting and area burning. However, this research focused on silvicultural considerations. It did not attempt to identify the environmental impacts of logging and burning. In particular, the researcher cautions that the reactions of permafrost to harvesting and site preparation needs further investigation.[65] Chemical and mechanical removal of brush can modify the micro-climate by increasing the amount of solar radiation reaching the forest floor and by reducing soil moisture losses from vegetative transpiration. The resulting increases in soil temperature and available moisture may favor natural or artificial reforestation, or improve the growth rate of established crop trees by releasing them from competition with brush for light, moisture and soil nutrients. However, its removal can have adverse effects on the micro-climate in terms of tree growth. Research has shown that brush can have a beneficial role; e.g., in California, brush cover increased ponderosa pine seedling survival; in western Montana, more favorable moisture and temperature relations were found under brush than in open areas, and ponderosa pine seedlings planted under brush had a higher rate of survival.[66] On the lower east slopes of the Cascades in central Oregon, it was found that soil moisture and temperature conditions under brush cover were most favorable for survival and establishment of ponderosa pine seedlings; conditions were least favorable under grass and on open bare ground.[66] Reforestation and afforestation by seeding and planting on approximately 26,000 acres annually alter the micro-climate gradually, until crown closure is achieved and the forest canopy is continuous. Significant changes will occur:[67]

- The mean maximum monthly air temperature in the forest will be several degrees lower than it was in the open.
- Forest soil temperatures will be slightly warmer in winter and 5°F. to 9° cooler in summer than in the open and freezing of forest soil, if any, will be less deep than in the open.
- Solar intensity will be greatly reduced.
- Relative humidity of the air within the forest will be 3 to 12 percent greater than in the open, and evaporation of moisture from the forest floor will be much less than from soil surfaces in the open.
- Wind velocities within the forest will be much lower than those in the open.

Precommercial thinning increases the intensity of sunlight within the young stand, increases air and soil temperatures and makes more soil moisture available for use by the residual trees.

Protection

Backfiring can affect the local forest climate. The effect of a light burn, confined to the forest floor, might be insignificant. A hot backfire, particularly a crown fire, can kill all vegetation, consume the organic material on the forest floor, and have the impacts on micro-climate described under area burning in the preceding subsections.

Cutting Practices

Depending upon the extent to which they open the forest canopy, all cutting practices affect the micro-climate. The impact is estimated to be insignificant (light selection cutting), moderate (intermediate shelterwood cutting or commercial thinning) or great (extensive clearcutting). To varying degrees, each type of cutting increases solar intensity, air and soil temperatures, surface evaporation, and air movement and wind velocity; and decreases vegetative transpiration and relative humidity.

Climatic reactions upon the forest ecosystem are variable. Increased sunlight stimulates the sprouting and growth of branches on stems of trees; higher soil temperatures and more available soil moisture may accelerate tree growth; increased wind velocities may cause wind-throw of reserved trees in a partially cut area or along the edge of a clearcutting. The altered micro-climate may favor or inhibit forest regeneration.

Logging Methods

Short term emmisions of pollutants from the engines of machines and dust from yarding operations will affect air quality very slightly.

Transportation

Right-of-way clearing for 500 miles of forest roads constructed annually has impacts upon the local climate which are similar to those of clearcutting. Several of the road construction activities can cause temporary degradation of air quality by emission of engine exhaust fumes and particulate matter. Dust from construction operations may be heavy locally and its effect may be accentuated by increased movement of air and higher wind velocities in the corridors created by right-of-way clearing. Transportation of logs by truck can degrade air quality along a forest road. During dry weather, trucks operating on unsurfaced roads or on gravel surfaces may raise heavy clouds of dust. On heavily used mainline roads, dust may be noticeable for long periods each day. Any road construction operations in the Taiga Sub-biome could have important effects on local climate, particularly on soil surface temperatures and thawing of permafrost, however, these effects are presently not fully known.

6. Impact on Vegetation[68-81]

a. Terrestrial Vegetation

Throughout the Biome certain timber management practices result in partial to complete, or nearly complete removal of one or all layers of forest vegetation including the overstory, understory, shrub layer, herbaceous layer and forest floor. Such an impact may be considered short term since revegetation usually begins soon afterwards with regrowth of residual plant species and invasion by species adapted to open conditions. These pioneer species may be herbaceous, or woody vegetation, including tree species, depending upon the local situation. Timber management practices also have long term impacts because of the time necessary to completely develop a new forest that resembles the one removed. The establishment of disclimax species and man-caused seral stages could result in a forest that is more susceptible to disease and insect outbreaks.

Forest Development

The short term impact of scarification on some 1,000 acres annually, mechanical brush cutting on less than 100 acres annually, area burning on about 9,000 acres annually, and chemical weed control on 5,000 acres annually is the partial or completed destruction of vegetation. Actions applied to a lesser intensity, may have short term impacts when the removal of vegetation is limited to one vegetative layer or only a small proportion (one half or less) of the total area. These actions may include scarification in strips or patches, spot burning, burying of slash, chemical weed control of a limited number of species which restrict commercial tree establishment or growth and precommercial thinning. Mechanical trenching and furrowing, spot burning of hand piled areas, chipping of slash, hand clearing and cleaning of competing vegetation, chemical weed control by hand application, mulching, snag felling and pruning have negligible impacts on vegetation. None of the remaining forest development practices damage vegetation. Their short term impacts are related solely to reestablishment, growth and protection of vegetation. These practices include tree improvement, tree seeding, tree planting, baiting, fencing and screening, and fertilization.

All development practices have beneficial long term impacts if they work as intended; trees will be regenerated early and grow at a fast rate thereby developing a new forest without extensive delays. Some practices, however, may impact vegetation in the reverse of what is intended if misapplied. Examples include: (1) scarification that compacts soil, or removes soil or shurb layers that were providing conditions suitable for tree regeneration, (2) area burning that removes desirable (for tree regeneration) shrub cover, causes soil erosion or rapid invasion of other unwanted vegetation, and (3) chemical weed control that removes one type of undesirable vegetation only to have its place unexpectedly taken by another undesirable type. In general, adverse long term impacts from scarification and area burning are most likely to occur on relatively "warm-dry" sites in all vegetative zones of the Coniferous Forest Biome, especially where soils are shallow, and coarse and humus layer is thin or absent. Long term adverse impacts will also result from use of heavy equipment on wet soils, resulting in compaction. An outside possibility exists that tree improvement will produce Douglas fir trees that are overspecified for rapid growth in a commercially desirable form and underspecialized with regard to resistance to disease, drought or other destructive agencies. Finally, tree planting or seeding can represent a tendency toward monoculture where such efforts involve a limited number of species.

Protection

Protection measures benefit vegetation in the long term by insuring continuance of existing forest conditions. The short term adverse impacts of backfiring may include complete, or nearly complete, destruction of vegetation on the burned area. Fire line construction will destroy vegetation directly and also indirectly when excess erosion occurs. Retardants have no known adverse impact.

Cutting Practices

The short term impact of clearcutting about 20,000 acres annually is the complete removal, through tree harvesting, of the upper vegetal layer and the partial damage to the lower vegetal layers in the course of falling operations. Clearcutting will produce about 500 miles of cutting edge annually where standing trees are exposed to wind. In some cases subsequent windthrown trees may endanger adjacent vegetation by providing a breeding ground for insects or fuel for wildfire. Clearcutting may also increase fire danger on cut-over area by exposing it to the drying effects of sun and wind until the new stand develops a closed canopy. From the long term point of view, clearcutting tends to develop stands that contain trees of approximately the same age and of species that grow well in full sunlight. Assuming no artificial reforestation efforts are taken, the natural rate and degree of recovery will vary by the conditions that characterize the impacted area. Clearcutting on relatively cool-moist sites in certain vegetative zones normally results in the natural regeneration of trees and, other vegetation in less than 20 years. These zones include:

- Northwest Coastal Sub-biome
  - Western Hemlock Zone
  - Sitka Spruce Zone
- Montane Sub-biome
  - Douglas-fir Zone
  - Western Hemlock Zone
  - Mixed Conifer-Mixed Evergreen Zone

Clearcutting on cool-moist sites does not, however, normally produce tree regeneration so fast that herbaceous and other woody vegetation are excluded. However, there are instances during which this vegetation is dominant or thrives in association with tree regeneration. Clearcutting on relatively warm-dry sites in all zones of the Northwest Coastal and Montane Sub-biomes, in high elevation zones where true firs are present, and anywhere in the Taiga Sub-biome normally results in the regeneration of herbaceous and non-coniferous woody vegetation to the virtual exclusion of many coniferous species over extended periods of time, sometimes as long as 25 years or more.

The short term impacts of shelterwood cutting on some 65,000 acres annually are much less than those of clearcutting; since only a proportion of the total vegetation, usually 50 percent or less, is removed. Shelterwood cutting may expose large areas to wind and any resulting windthrown trees may endanger vegetation by providing a breeding ground for insects and fuel for wildfire. Shelterwood cutting also opens the forest to drying effects of wind and sun thereby increasing fire danger, although to a lesser extent than clearcutting. Shelterwood cutting can also perpetuate and spread dwarf mistletoe thereby damaging or possibly killing susceptible tree species such as lodgepole pine.

With regard to long term impacts, shelterwood cutting normally results in the natural establishment of tree regeneration thereby avoiding a long period of exclusive dominance by herbaceous and non-coniferous woody vegetation. Like clearcutting, it usually results in an even-aged stand but favors species better adapted to shade. Shelterwood cutting is often the only feasible way of obtaining early tree regeneration in many zones, especially on warm-dry sites, within the Montane (including the Ponderosa Pine Zone, White Fir Zone and Douglas-fir Zone) but is uncertain in others

(Mixed Conifer-Mixed Evergreen in southwestern Oregon); it has also provided early tree regeneration in the Northwest Coastal sub-biome on both "cool-moist" and "warm-dry" sites. This practice opens the forest canopy and allows increased growth of herbaceous and shrub layers although not to the extent of clearcutting.

Seed tree cutting usually impacts vegetation much the same as clearcutting. The number of trees left standing after logging are generally few in number but provide a better chance for natural regeneration and recovery than clearcutting. Short term impacts of selection cutting are the least of any of the final harvest cutting practices since only a small amount of vegetation is destroyed or removed. Selection cutting does not normally increase danger to forest vegetation from wind, fire or insects due to the absence of large openings or heavy concentration of slash over large areas. However, selection cutting can perpetrate and spread dwarf mistletoe thereby damaging or killing susceptible species.

Long term impacts of selection cutting results in uneven-aged stands composed of species adopted to shade; trees of all ages, from seedlings to mature trees. Tree regeneration almost always occurs in small openings soon after mature trees are removed; herb or shrub dominated areas of any significant size rarely occur. The selection method usually results in the regeneration of forest trees, on relatively warm-dry sites in the Ponderosa Pine Zone of the Montane Sub-biome. Selective cutting in old growth Douglas-fir forests in the Western Hemlock and Sitka Spruce Zones of the Northwest Coastal Sub-biome often results in the regeneration of only shade loving western hemlock and assorted species of non-coniferous woody vegetation, primarily shrubs. The short and long term impacts of commercial thinning and mortality salvage are relatively insignificant due to the minimal amounts of vegetation removed.

Logging Methods

The short term impact of ground systems such as tractor skidding and high-lead yarding is to partially destroy or damage the lower vegetal layers. Logging can cause damage to residual trees resulting in disease, particularly in such species as western hemlock and white fir. Unless extensive soil compaction or loss of soil by erosion occurs the long term impact is to contribute to a relatively early natural regeneration of tree species. Logging methods such as horse skidding, aerial systems, balloons and helicopters do not impact the herbaceous and shrub layers. Consequently, the early development of a new forest is only enhanced where tree species already capable of continued growth are present in the understory following falling operations. However, horse skidding, balloon and helicopter logging are currently limited to less than 200 acres a year.

Transportation

Road construction practices have a severe short and long term impact on vegetation. In addition to the actual removal of vegetation from the area to be surfaced, road construction frequently destroys vegetation over extensive areas below the road cut or fill where sidecast material (soil, rocks, brush, logs) is pushed by tractors, dumped by trucks or blasted by explosives. Land covered by sidecast if often much slower to revegetate than adjacent land due to sterility of the material and depth to which it covers residual vegetation. Sterile material impedes revegetation by invading plant species and deep covering of residual plants impairs their ability to resprout. Land covered by the road surface is permanently a non-producer of vegetation except for small isolated spur roads that are sometimes abandoned. Even the latter, however, will normally be incapable of producing vegetation similar to adjacent land due to their compacted condition. Roads also provide positive long term benefits by serving as the means by which men and equipment may be moved into the forest to protect vegetation from fire and insects, and conduct reforestation efforts as well as provide access to the public.

b. Aquatic Vegetation

Forest Development

Practices such as seeding, planting, mulching, pruning, burying, precommercial thinnings, and hand clearing and cleaning do not usually have an impact on aquatic vegetation. Mechanical brush cutting along streams could temporarily damage aquatic plants while chemicals used to control weeds could kill desirable aquatic vegetation. Area and spot burning could cause short term adverse effects on aquatic plants by killing them if done along streams or beside lakes and marshes. Extensive snag felling in streams or lakes could result in the immediate death of some aquatic plants and long term environmental changes detrimental to other plants due to decomposition of organic material.

The addition of nutrients through fertilization to neutral waters may benefit aquatic plants by increasing their growth. Nutrients carried into lakes, reservoirs and ponds, however, could intensify problems caused by aquatic plants if the receiving water was already rich in nutrients. In such instances indirect impacts could include extreme algae blooms detrimental to uses of water for drinking, recreational and fish kills due to oxygen depletion during winter or summer months.

Protection

Use of insecticides or fungicides to protect forests would have a direct impact if the chemicals used are lethal to aquatic plants. Fire line construction and backfiring can destroy aquatic vegetation, especially in the Taiga Forest.

Cutting Practices

Cutting practices which remove most of the timber adjacent to aquatic ecosystems can have a direct impact on aquatic plants. Clearcutting along streams or around lakes, ponds and marshes causes more immediate loss of aquatic plants than other cutting practices. Extensive clearcutting in a watershed may result in undesirable algae blooms, particularly if large increases in water temperatures result from the cutting practice. Under some situations cuttings that result in slight increases in water temperature and more light penetration may benefit aquatic plants by creating better growing conditions. Relatively light cuttings like commercial thinning, selection cutting or sanitation-salvage cutting have minor impacts on aquatic plants.

Logging Methods

Timber falling and bucking, by itself, has no immediate impact on aquatic vegetation unless trees are felled into aquatic habitats thereby destroying plants. Long term adverse effects would occur if debris, slash and tree tops are not removed during logging.

Both short and long term adverse effects on aquatic plants occur when logs are skidded across streams or wetland, resulting in sedimentation of both running and standing waters. Excessive sedimentation accelerates the natural process of plant succession. This may be beneficial in some developing ecosystems, but sedimentation in most cases is considered detrimental because it reduces the quality and amount of aquatic habitat in the total environment. Crawler tractors and downhill high-lead logging systems generally cause more sedimentation than other ground systems of logging, and would therefore have the most adverse effects on aquatic plants. Aerial systems would cause less sedimentation and loss of aquatic plants than ground systems of logging because logs are partially or totally suspended above the ground during yarding.

Transportation

Studies have shown that more sedimentation of aquatic habitat result from road construction and maintenance than from yarding operations. (See long term impact of sedimentation on aquatic plants as discussed above.) Aquatic vegetation can suffer both short and long term negative impacts whenever construction occurs adjacent to or in waterways. Aquatic plants may be damaged or removed by clearing and grubbing, excavation of all types of material, and embankment and channelization of streams. Installation of structures in streams may have a slight negative impact on aquatic plants at the construction site.

Maintenance

Maintenance of roads and structures can cause additional sedimentation in water courses which shortens the gradual succession of plant communities. Clearance of landslides from roads can be detrimental to plants if soil and debris are sidecast into streams. Aquatic plants could be damaged by chemical applications to control brush along waterways.

7. Impact on Animals

a. Wildlife - Terrestrial[82-85]

Forest Development

Tree improvement practices may increase the growth rate of coniferous forests thereby adversely affecting browsing animals such as deer by reducing the time that they can use the reforested area. Forest dwelling species including some birds, small mammals, and mammalian predators may benefit through the cover afforded by rapid forest regeneration. Scarification, mechanical brush cutting, burning, and chemical weed control, etc., will have a temporary adverse impact on small ground dwelling mammals such as brush rabbits, mice, moles, shrews, and a few ground nesting birds such as mountain quail and grouse and on deer and elk by eliminating brush cover. Where chemical toxicants are used to kill vegetation, sources of food and cover will be reduced. The burning or burying of brush and logging slash would be detrimental to small ground-dwelling or nesting mammals, birds, reptiles and amphibians, but would benefit larger animals since it would permit ease of movement, and permit the growth of valuable browse species. Chemicals such as 2,4-D and Atrazine may destroy the cover used by small mammals, amphibians, and reptiles. Use of chemicals may deny wildlife use of extensive areas during crucial periods such as during the winter and spring. Use of defoliants such as 2,4-D in large stands of alder and other hardwoods may remove necessary escape cover used by deer, elk, and other animals and birds. Use of Atrazine may at times be beneficial to browsing animals by removing grass competition with browse species.

Seeding and planting promotes or augments natural reforestation and may hasten the time interval of natural regeneration (see tree improvement above). If the seed or planting stock is treated with non-toxic repellents, such as thiram, there would be little effect on wildlife. However, rodenticides such as endrin and strychnine can cause losses to predators that have eaten the poisoned animals.

Baiting would be most detrimental to many small rodents including mice, some shrews, ground squirrels, woodrats, porcupines, hares and rabbits, and mountain beaver. Moles and gophers are also sometimes controlled through poison baits. If strychnine is used, predators, either avain or mammalian, could be killed by the secondary effects of the baits after eating dead or dying rodents that had ingested the poison baits. Herbivores may at times benefit through the baiting and subsequent control of overpopulations of mice, rabbits, and gophers that may destroy browse species by girdling, etc. Fencing and screening can be detrimental to animal movements if conducted on an extensive basis. Little impact would occur by screening individual trees, but extensive fencing can interfere with normal animal movement, and may entrap the young of deer and elk. Adult animals can become entangled in nylon-mesh fencing used in some planting sites.

Snag felling would adversely impact many birds and small animals since they are used for denning, nesting, and food storage. In addition, spike tops and large dead snags are needed near eagle and osprey nest trees for perches, and for the young to use when learning to fly. Larger dead snags or hollow trees may be used by furbearers including some of the larger predators. (See remarks under cutting practices.) Snags and dead trees also harbor insects that furnish an extensive food supply for many insect-eaters including woodpeckers and creepers. Applications of "superphosphates" and other high nitrogen content fertilizers increase the palatability and general use of almost any treated plant species by herbivores and rodents. Precommercial thinning and pruning may benefit wildlife dependent on a brush understory by opening up the canopy and allowing sunlight to reach the forest floor. Since sunlight influences both the quantity and quality of forage, browsing animals would generally benefit from thinning practices.

Protection

The control of a pest species by another insect species is generally of no consequence, from a wildlife standpoint, beyond the immediate effect of the predator on the prey. Habitat used by wildlife can be destroyed by infestation of borers, leafeaters, sap feeders, and other insect pests. Webworms may destroy forage needed by wintering deer, but the caterpillars may, in turn, provide a valuable food source for many insect-eating birds. The use of chemical insecticides is of more immediate consequence to wildlife. The use of DDT, for example, has had adverse effects on many forms of bird life, both by killing them outright, eliminating food supplies, or disrupting their reproduction. Other insecticides used to control damaging species may also kill non-target insects including predatory species.

Cutting Practices

Nearly all wildlife are initially affected adversely by the sudden impact of timber harvesting. The immediate removal or destruction of habitat including nesting, fawning, calving, wintering, and escape cover can result in the drastic displacement or actual loss of small birds and animals. Since most wildlife are highly territorial, displacement can be as fatal as the actual harvesting effects. This sudden violent impact is of relatively short duration, however. Differences between cutting practices is a matter of degree with clearcutting and seed tree cutting generally the most damaging and selective cutting the least damaging. Shelterwood cutting probably occupies a model position in this regard. Some species of wildlife, however, are quite tolerant of, or respond favorably to, the actual removal of the forest overstory and subsequent human activity. Deer, especially blacktailed deer, respond favorably to the removal of closed canopies and subsequent availability of nutritious browses, grasses, and forbs. Rodents, including ground dwelling squirrels, mice, and rabbits usually increase with brush regeneration following logging. Small predators that would prey on these rodents would also benefit.

Regardless of the cutting practice employed, the harvest of old growth forests will have an adverse impact on northern spotted owls, goshawks, Copper's hawks, sharp-shinned hawks, eagles, and other species associated with old growth stands due to the destruction of their unique habitat and the accompanying reduction in food supplies. Since these old growth ecosystems will not be replaced over time, both the short and long term effects will be to reduce and in some instances eliminate certain species populations.

Roosevelt elk are usually benefitted by timber harvesting activities, if it consists of scattered small clearcuts. Most large mammalian and avian predators are adversely affected by extensive loss of cover and accompanying human activities. In general, both clearcutting and partial cutting practices affect wildlife species (to varying degrees) prior to return to a closed canopy condition as follows:

Positive Impact	Negative Impacts
Mammals	
Deer (Blacktailed & Mule)	Bear
Roosevelt Elk (1)	Cougar
Snowshoe hares	Wolf
Ground squirrels	Lynx
Mice	Mink
Moles	Fisher
Bobcat	Marten
	Wolverine
	Tree Mice
	Flying squirrel (2)
	Mountain Beaver
	Shrew
Birds	
Blue grouse	Eagles
Ruffed grouse	Ospreys
Mountain quail	Northern spotted owl
Bandtailed pigeon	Chickadees
Sparrows	Nuthatches
Thrush	Winter wren
Wrens	Accipiter hawks
Junco	Franklin's grouse
Warblers	Dippers (water ouzel)
	Woodpeckers (2)
Amphibians and Reptiles	
Toads	Salamanders
Lizards	Tree frogs
Garter snakes	

(1) Rocky mountain elk usually respond favorably to some openings of closed canopy overstories, but are much less tolerant of human activity than are Roosevelt elk. Both animals must have escape and wintering cover interspersed with forest openings.

(2) Many small mammals, small owls, and woodpeckers are indirectly affected by logging where the cutting of merchantable trees also means the loss of snags and dead trees. Other birds dependent on cavity nests include tree swallows, titmouse, creepers, and near waterways, wooduck, bufflehead, golden eye, and the hooded merganser. Animals can include squirrels, mice, fisher, marten, bats, raccoons, ringtailed cat, and bear.

Logging Methods

Ground systems that disturb the soil stimulate browse production favorable to herbivores and provide some benefits. In general, crawler tractor skidding, high-lead yarding, mobile yarders, and jammers, create soil disturbances beneficial to animals dependent on grass and browse production. Small mammals and ground dwelling birds, amphibians, and reptiles will obviously be destroyed or temporarily displaced by this type of operation. Most wildlife benefits, however, would accrue from horse skidding and skyline, balloon and helicopter yarding which causes a minimum of disturbance. Again, slash distribution and disposal is of importance; much standing slash impedes movement of larger animals such as elk and deer, but encourages mice, ground squirrels, rabbits, hares, and other small mammals and birds that are normally found at or near ground levels. Supposedly, the aerial types of yarding would be less prone to destroy snags and dead trees through normal logging attrition than would the high-lead and ground skidding systems. As mentioned previously, snags and dead trees are of great importance to many birds and mammals. Another prime importance of aerial yarding is that its use precludes much of the road construction necessitated by more conventional methods. Roads greatly reduce the available wildlife habitat, and cause many species to abandon former habitat because of greatly increased human disturbance.

Transportation

Probably the greatest negative impact on wildlife stems from road construction. As with timber harvesting, there is an initial sudden and disruptive effect on nesting and sometimes wintering wildlife. Also, road rights-of-way permanently remove thousands of acres of wildlife habitat, encourage harassment of wildlife through ease of vehicular access, and preclude use of vast areas to wilderness-inhabiting species. While the larger predators, both avian and mammalian are the most adversely affected, there are probably few wildlife species that are directly benefitted by road construction and use. Obviously, some "edge" effect along roads is created in closed canopy environments that will be used by some species of birds and animals, but effects are still basically negative. The deer or grouse using roadside grass-legume bank stabilization seedings may be killed by the speeding vehicle or road hunter.

G. Wildlife - Aquatic

Forest Development

The impact of some development practices normally has a stabilizing effect on the watershed, riparian vegetation, and the stream channel. Specific actions such as seeding and planting tend to improve the watershed, and consequently basic water quality over time, and thus benefit aquatic animals. However, actions such as mechanical brush cutting, trenching and furrowing, scarification, burying slash, and precommercial thinning may cause short-term water quality problems associated with siltation and streambank degradation. Debris could also be deposited in the streams from such operations resulting in a reduction of the oxygen content of the water and blocking fish passage. Area burning and spot burning of piles and concentrations of slash could cause water quality changes if the work is on or immediately adjacent to streams. Impacts would be temporary lethal increases in water temperature and additions of chemicals or ash directly into the water. Chipping, hand clearing, hand cleaning, and pruning could add to the organic load of the streams thereby reducing oxygen content. Weed control, precommercial thinning and baiting when conducted with chemicals could cause direct kills to fish, clams, mussels, crustaceans, and aquatic insects and drastically harm aquatic communities. Fencing and screening could have a positive impact through protection of overhanging streamside vegetation that provides a habitat for terrestrial insects that fall into the water and become food for fish. Snag felling directly into streams may cause blockages to fish migration and add to organic load in the water. Controlled snag felling operations could have a positive effect by providing larger aquatic animals, such as fish, additional cover in open streams. Fertilization of watersheds could result in a build-up of nutrients in lakes or reservoirs in the watershed. The small addition of nutrients to some lakes already undergoing eutrophication might amplify water quality problems and cause negative results on aquatic environment. The aquatic biota in neutral waters in the Taiga Forest and high elevation areas of the Montane Forest may actually benefit form increasing nutrients by providing more rapid growth of aquatic plants and animals. The physical operations of moving fertilizer and chance of accident near streams could result in a detrimental impact on aquatic resources.

Protection

Forest protection actions concerned with control of insects and disease through predators and viruses would have little direct effect on larger aquatic organisms such as fish. A drastic reduction in the amount of terrestrial and aquatic insects could, however, have an adverse impact on fish and crustaceans through the reduction of the insect population used as a food supply by fish. Reduction of insects through insecticides may have two-fold impacts on aquatic organisms. The insecticides themselves may be directly toxic to forms of aquatic life. Those forms dependent on terrestrial and aquatic insects for food may die from lack of nourishment. Fungicides would normally have only a direct impact if the chemicals were toxic to aquatic organisms. Use of insecticides to maintain the general health of the forest and subsequent stabilizing influence on watersheds and water quality is a beneficial long-range impact on aquatic wildlife. However, the use of any toxic chemical can have significant impacts on aquatic organisms, many of which are secondary in nature.

Activities during fire suppression work may have detrimental impacts on aquatic animals and organisms. Recent studies show that the most commonly used retardants, both powder and liquid, are toxic to fish and aquatic organisms. Concentrations of around 150 to 200 parts per million in water may be fatal to fish. Direct drops of retardant on small ponds, streams, and slow moving rivers may cause concentrations that will produce fish kills. Spills of retardants near assembly areas and airfields with subsequent drainage into stream systems may be lethal to aquatic animals. Fire line construction, especially with track vehicles, can cause subsequent erosion problems especially on steep grades. The Taiga Forest is probably the most delicate area for fire line construction. In permafrost areas, disturbance or removal of the vegetative mantle exposes frozen areas that quickly degrade and cause severe erosion problems. Water quality in receiving streams is degraded and siltation smothers aquatic organisms and destroys spawning grounds of some salmonoid fish. Post fire operations in commercial timber usually trigger a massive effort to remove all merchantable trees. The impact of massive logging operations on vast burned areas usually has the largest impact on aquatic ecosystems. Backfiring, as a method of fire control, may cause destruction of additional stream riparian vegetation and result in loss of cover and degradation of water quality for fish and other aquatic animals.

Cutting Practices

The primary impacts on aquatic animals from various forest cutting practices occur as a result of the removal of protective vegetation along streams and the deposit of debris and sediment in streams. Commercial thinnings, intermediate shelterwood cutting, selection cuttings and other partial removal cuttings probably have the least negative impact on water quality and streamside environment. In fact, water quality could be improved as a result of these practices by subsequent increases of vegetation on the forest floor and protection of the watershed. Clearcuttings will have an immediate detrimental impact on water quality in areas where trees adjacent to the stream or river systems are removed. Elimination of the forest canopy and riparian vegetation can increase water temperatures over optimum limits.

However, the addition of nutrients and the warming of water temperatures can be beneficial by increasingly aquatic biota productivity, particularly in cold infertile bodies of water. Any erosion originating on the clearcut area can result in the degradation of water quality in adjacent water bodies through sedimentation and siltation. Changes in annual water flow by this cutting practice could produce either positive or negative impacts depending on the biotic requirements of the animal.

Logging Methods

The impact of falling and bucking on water quality and the aquatic environment is immediate and may cause short-term problems. Falling methods that permit a large concentration of trees and debris in streams causes adverse impacts by the addition of organic matter which reduces oxygen in the water and stream blockage. Accidental spills of oil, gasoline, and other materials used with falling equipment may add undesirable ingredients to small tributary streams and be toxic to aquatic organisms.

The movement of logs by ground skidding or yarding operations can have a significant impact on the water quality of streams and lakes by the addition of sediment causing siltation and excess turbidity during periods of heavy runoff. Streambanks and bottoms could also be damaged and scoured. The heaviest impact may be from crawler tractor skidding due to erosion and severe disturbance of the soil mantle. Horse and rubber tire skidding normally reduce the soil disturbance and subsequent reduction in deposits on stream environment. Various types of skyline systems have little direct impact on aquatic habitats. Large amounts of debris left on stream bottoms following the logging operation can be destructive to aquatic animals, especially fish, clams and mussels, and aquatic insects, and crustaceans. Degradation of habitat comes from lower dissolved oxygen through addition of organic material, increased water temperatures, and physical damage to the stream bottom and banks. Large logs and heavy debris left in steep draws and along streambanks may cause long-term drainage problems which result in destruction of fish populations and stream habitat. Sluice-outs, during periods of heavy precipitation, cause complete destruction of the aquatic habitat from physical changes of the environment. Offsite degradation of aquatic environment is common from sediment and debris in lower river systems and estuaries.

Transportation

Studies in most Western States show that road construction has one of the most serious impacts on water quality. The impacts are associated with soil disturbance during the construction phase. The action may result in stream channel changes, blockages to fish and addition of sediment load to streams so as to reduce aquatic organisms. There are also drastic changes in the aquatic habitat with subsequent reductions in spawning success and condition of higher animals such as fish. Clearing and grubbing pose immediate problems of debris blocks in streams and temporary turbidity from siltation. Excavation of earth and rock, if located near streams, will add silt load and increase turbidities which are destructive of aquatic organisms. Excavation and removal of spawning gravels in streams may destroy historic spawning grounds for both anadromous and resident fish. Rock and gravel areas in streams are usually food producing areas. The immediate effect is destruction of aquatic insect habitat. The long-range effect would be reduction of food for the larger organisms such as fish and crayfish. Improper embankments and compacting and grading may cause subsequent erosion that add sediment to streams and impair some of the habitat requirements. Stabilization techniques usually have a positive influence on aquatic animals by improving water quality. Rock crushing may require washing operations. Resulting sediment load from these operations may reach streams and smother habitat of aquatic insects, mollusks, and crustaceans. Spawning gravels are generally impacted with fine material and water quality degradation below standards may result. Bases and surfaces of roads may contain materials detrimental to aquatic organisms when washed into streams. Examples are clay and dirt surfaces that deteriorate during periods of heavy rainfall or freezing and thawing. Drainage ditches and culverts may concentrate waters to flow on erosive fill areas causing sediment deposits in streams. Structures in streams such as culverts, bridges, fords, and other crossings may become impassible barriers to migrating fish. Construction in streams at improper times and exposing materials such as portland cement and asphalt to streams may cause fish kills.

Maintenance

A variety of impacts to fish and other aquatic organisms may be caused during maintenance of roads, trails, and other access routes. Drainage structures may be altered on roads causing undue addition of silt and debris in streams. Repair of structures on stream crossings or of riprap may cause destruction of spawning beds or delay in migration of adult anadromous fish. The side cast of debris and slides during removal operations into streams may cause degradation of water quality for many miles below the problem area. Brush control along stream side roads may not be compatible with existing aquatic habitat and water quality. Excess destruction of vegetation may increase water temperature. Any herbicides entering streams through various routes can directly kill aquatic animals.

C. Domestic Livestock

Development

In general, there would be little impact on livestock grazing due to the extremely limited use of the forest by cattle, sheep, or horses. The process of mechanical brush cutting has a temporary disturbing effect on domestic grazing animals in the area. This effect is minor however when compared with the more positive benefits of the practice. The removal of brush eliminates obstacles that restrict or hinder animal movement. It also removes vegetation that is undesirable for grazing by domestic animals and opens up the stand so desirable forage plants can occupy the site; as a result, the area treated can be used more uniformly and with more livestock. Area burning has a disturbing effect on grazing animals in the vicinity. However, it results in the removal of debris and other materials of little value for forage. The removal of this material provides additional space for the development and reproduction of grasses and other desirable forage species. Chemical weed control practices to control herbaceous vegetation can have an adverse impact on grazing animals by changing the composition of forage plants available for use. The application of some chemicals may kill out the desirable forage species while the use of others would eliminate undesirable competing vegetation and improve the quality and quantity of livestock forage available. The consumption of forage plants that have been treated chemically may have a direct negative impact on the grazing animals themselves. Fencing and screening would restrict the movement of livestock and the area available for grazing use. In some cases, important watering sources would perhaps be fenced out thus reducing the amount of grazing use that could be made on adjacent areas. Fences properly or advantageously located could be used for the purpose of manipulating grazing animals in a systematic method beneficial to the vegetation and related resources as well as to the livestock themselves.

Protection

There are several protection practices that could have an impact on sheep, cattle, and horses. However, at this time not enough is known to evaluate either the positive or negative impacts. For example, the use of insecticides and fungicides could directly affect plant species important for livestock forage. The utilization of plants by domestic grazing animals that have been treated with an insecticide or fungicide could have an effect on the health and well-being of the animal itself. The impacts resulting from these kinds of actions would depend upon several factors such as the time, amount, and frequency of their use.

Cutting Practices

The various cutting practices result in partial to complete, or nearly complete, removal of forest trees and other vegetation. Long-term effects on domestic livestock vary according to the practices employed. A closed forest canopy fully occupies the site and produces few desirable grass or forage species suitable for use by livestock. Also, the abundance of trees and vegetation tends to hinder or restrict animal movement. Management and cutting practices that open up the stand provide space for the growth and reproduction of desirable forage plants and allow for free animal movement. In general, the more open the stand the more grasses and other forage plants that are available for domestic livestock grazing use.

Logging Methods

Logging activities which disturb the soil effect livestock forage conditions and the livestock themselves. These effects vary with the kind of logging methods used and rehabilitation measures undertaken. Logging activities may result in detrimental impacts to livestock if skid trails and other disturbed areas are not rehabilitated by reseeding or other measures that will stabilize the soil and provide livestock forage. Such areas, if properly protected and managed, will increase in value for domestic livestock grazing purposes. In general, however, all timber management practices have a minimal impact on livestock because of their limited use of forested national resource lands.

Transportation

Road construction, logging, and hauling activities with their attendant noise and human activity may effect the free and accustomed movement of livestock and have temporary disturbing effects. Adverse effects of a more permanent nature result from land taken out of production due to the construction of roads, trails, and landings. This will also occur in areas where severe soil disturbances cause landslides and extreme soil loss.

8. Micro and Macro-Organisms

a. Soil Organisms

While some practices will have a beneficial impact on the organisms that are found on or below the soil surface, others will be detrimental to the extent that populations will be decreased or inbalances created. Normally, reductions in populations will result in lesser amounts of nutrients being made available to the producers, which in turn, will reduce the productivity of the biotic community. Conversely, increased populations will usually result in more nutrients being available to members of the biotic community, either directly or indirectly. In general, those practices that reduce soil moisture, diminish carbon supplies, or affect soil aeration through compaction will have an adverse impact on soil organisms. However, this impact will usually be of a very short duration because of the dynamic reproductive characteristics of these organisms. As a cautionary note, however, it should be pointed out that the state of knowledge regarding the relationship of many practices with soil organisms is not very far advanced.

Forest Development

Practices that may have a short-term adverse affect include areas severely burned in the course of area and spot burning. Research findings suggest generally that burning has the greatest effect on microbiological activity in the uppermost part of the surface soil. Intensity of burning was shown to be important in determining whether or not micro-biological properties of the soil were altered. In most cases, unburned and lightly burned soils were not greatly different in numbers of organisms or ratio of bacteria to actinomycetos. After an initial reduction, marked increases were noted in the microbiological populations of severely burned soil two years later.[86] Any areas that become compacted by heavy equipment in the course of scarification or mechanical trenching and furrowing will result in reduced populations of organisms. Massive spills of toxicants during chemical weed and brush control will have severe impacts through soil sterilization. Fertilization, chipping, seeding, and planting will have both a beneficial short-term and long-term impact on soil organism populations. Hand clearing and cleaning, precommercial thinning, and pruning are not expected to have any significant impact, one way or another.

Protection

Excessive amounts of insecticides, fungicides and other toxicants will have an adverse effect during the life of the residual chemical and any concentration spills will increase this impact. Compaction and erosion resulting from fire line construction will have a short-term adverse impact. As in the case of any actions resulting in soil erosion, the impact will be increased and extended over time in the Taiga Forest where relatively lower populations of organisms are found due to climatic and soil conditions.

Cutting Practices

Partial cutting practices such as commercial thinnings, shelterwood and sanitation salvage operations will have little if any impact on soil organisms. Clearcutting and seed tree practices will temporarily reduce populations due to decreased soil moisture content, particularly in the Montane Forest.

Logging Methods

The employment of ground systems such as tractor and high-lead logging on sites conducive to erosion will have detrimental impacts because of the loss of the organic layer. The impact will be expanded on tractor operations as a result of soil compaction. Aerial systems will have no impact except, as in the case of most logging methods, on the landing areas, due to oil and gas spillages, topsoil removal, and compaction.

Transportation

Both short-term and long-term adverse impacts will result from road construction practices that remove the topsoil, compact the soil, thereby reducing aeration, or decrease soil moisture content. Areas under road beds will be impacted during the life of the facility and any continuing erosion will have long term effects.

b. Aquatic Organisms

Any of the timber management practices that affect water quality could have a direct effect on populations of these aquatic plants and animals in aquatic ecosystems. Some activities may have a positive impact, but many actions would result in detrimental population changes effecting other animals and human beings because these organisms are basic components of the food chain. Increased sedimentation is one of the most serious possible impacts because all aquatic environments are affected and many aquatic organisms cannot tolerate substantial increases above the natural geologic rate of sedimentation.

Development

Practices that may cause short-term negative impacts on water quality and hence micro-organisms include chemical weed or brush control, area and spot burning if adjacent to streams, scarification and mechanical brush cutting if beside streams, snag falling if in waterways, and hand clearing and cleaning if along streams.

Activities that tend to stabilize watersheds would have a positive impact on aquatic organisms. Such actions would include seeding, planting, mulching and fencing and screening. Fertilization could be beneficial by stimulating growth of phytoplankton, especially in some neutral waters of each sub-biome. Fertilization of young trees would cause some negative impacts if receiving waters (especially lakes or ponds) are already rich in nutrients. In these cases, dense blooms of algae could cause undesirable tastes or odors in drinking water and interfere with swimming or fishing. Profuse growths of phytoplankton and other aquatic plants can also cause fish kills due to oxygen depletion.

Protection

Use of insecticides and some herbicides could kill zooplankton and fungicides may be directly toxic to phytoplankton for the life of chemicals used. Loss of these basic food items would indirectly effect all aquatic animals. Fires have an adverse short-term effect on water quality and minute plants and animals. Fire suppression activities could also cause adverse effects on aquatic micro-organisms if retardants are dropped directly into water or vegetation along streams and around lakes is destroyed. Backfiring could also destroy ripairian vegetation and cause burning material to fall into waterways. Fire line construction often causes increased sedimentation of aquatic habitat and damage to aquatic organisms.

Cutting Practices

Adverse effects on all forms of small aquatic organisms are caused by cutting practices which (1) permit trees to be felled into streams or lakes thereby altering habitat and creating organic changes in water quality, (2) remove streamside vegetation thereby opening the canopy, exposing water to direct sunlight and increasing water temperatures, and (3) damage streambanks and beds thereby increasing sedimentation. Clearcutting usually causes the greatest impact when all of the trees along a water body are cut. Lighter cuttings such as sanitation-salvage, selection cutting, or preparatory shelterwood cuttings would generally have minor impacts on aquatic organisms.

Logging Methods

Short-term vegetative impacts on aquatic micro-organisms occur when trees are felled into the aquatic habitat. The increased water temperature and presence of organic matter reduces the amount of dissolved oxygen available for consumption by plants and animals. Conditions may deteriorate further if fuel used for machinery is allowed to enter small streams during logging operations.

Logging systems which result in the greatest amount of soil and habitat disturbance usually have the largest impacts on aquatic life, e.g., systems where logs are skidded across streams, downhill high-lead logging, or crawler tractor logging. Aerial or skyline logging systems cause the least impact on aquatic life. Systems which result in considerable debris remaining in stream channels after logging create high potentials for sluice-outs during floods. These sluice-outs completely change the physical characteristics of streams and destroy much of the biological productivity for several years.

Transportation

Serious adverse effects on all forms of aquatic life from road construction and maintenance were discussed under sections on aquatic wildlife and vegetation. However, another negative impact of excessive siltation not previously discussed occurs when high levels of suspended material prevent photosynthesis of phytoplankton for prolonged periods of time. This causes a reduction in the basis productivity of the aquatic ecosystem.[87]

9. Impacts on Human Settlement and Land Use

Whereas the former parts of this section dealt primarily with the direct unmitigated impacts of timber management practices on the biological and physical components of the forest community, this part and the next will expand the dimension so as to include man. Consequently, the emphasis will be mostly on the impact of the timber management program on changing human values as opposed to the relatively hard and fast laws of nature. The basic underlying assumption used in describing these impacts is that timber management will be given precedence over all other potential uses.

a. Human Settlement

Scattered throughout the Coniferous Forest Biome are many small communities and hundreds of isolated farms, ranches, vacation retreats, and mining camps. Where timber management activities are taking place near such human habitation there are risks of adverse impacts occurring.

(1) Health and Safety

Aerial spraying of chemicals for brush and weed control, if allowed to drift and settle on inhabited areas, or enter food supplies, streams or open water, can be injurious to human health and welfare.

Smoke from slash burning may have temporary adverse effects on people with respiratory problems. Visibility may at times be restricted where slash burning occurs near roads and highways, creating hazardous driving conditions. These conditions may also occur in conjunction with quarrying and rock crushing activities associated with road construction.

Flash floods, land slides, and mudflows resulting from obstructed waterways, extensive cutting, road construction, and other causes can be hazardous both on-site and off-site to public health and safety. Sedimentation of waterways could have a significant adverse impact on those communities in western Oregon whose municipal watersheds depend largely on water emanating or flowing through Bureau administered forests.

Where logs are being hauled out of the forest there is always the danger of collisions with motorists and others using the logging roads.

Hazards to the health and safety of workers, both government and industry, can occur in practically all phases of timber management. Accidents leading to death and injury most commonly occur during harvesting and removal operations.

(2) Employment

No significant adverse effects on employment are felt to be associated with timber management. The frequent, sometimes sharp price changes in the timber industry do affect rates of employment, particularly in wood processing and manufacturing, however, this is not an explicit impact. On the other hand, there are obvious beneficial effects on employment. Many jobs are created as a direct result of the timber management program. Other jobs, performing services for the timber related employees, are also created. The annual timber production in western Oregon will continue to support 13,500 primary timber related jobs and 20,000 secondary jobs (retail trade, service, etc.). These jobs currently represent a percent of the total employment in the region, but range as high as 35 percent in some local areas. The annual production from the remaining forests in the contiguous United States will support some 2,000 primary and secondary jobs.

(3) Local and Regional Economies

There are no known adverse impacts on the local and regional economies. Timber production is the basis for many local economies, particularly in the Northwest Coastal Forest as described under Section K, Chapter II, Description of the Environment. Other regional economies are also benefitted, though to a considerably lesser degree.

b. Mineral Development

Most of the proposed practices can have emotional impacts upon prospectors or mining claimants. Many of these people are individualists who look askance at any activity that they consider an encroachment of their legal rights to explore and develop mineral deposits on public lands for personal gain. This attitude can embrace any one or all of the activities associated with the timber management program. Nonetheless, the impact is essentially a personal one without significant effect on the progress of actual mineral development or the economic welfare of the individuals involved.

c. Wilderness

With the exception of the Taiga Sub-biome, few of the public commercial forest lands meet the basic criteria (established by Federal legislation) necessary for classification and formal withdrawal as wilderness, i.e., large areas untravelled by man, with no evidence of his presence.

Nevertheless, some public values might be jeopardized by conducting timber management practices in areas where the aesthetic values of scenery and open space might be viewed as semi-wilderness in character. An example would be the opening up of an extensive area of old-growth timber to harvesting, thereby destroying its intrinsic virgin values.

The Taiga Forest contains many de facto wilderness areas which would qualify for withdrawal under Federal criteria and the impact of timber management on any of these areas would destroy their wilderness value.

d. Recreation

The variety of recreational values and the broad array of timber management practices make many land use conflicts inevitable. Although some recreational activities may be benefitted by timber management, others will not. Quite often a practice may be both beneficial and detrimental at the same time, the choice being dependent upon the user's point of view. As an example, for many years following logging, a clearcut area may have lost all apparent value to a camper or hiker. However, its invasion by vegetation may produce forage for wildlife, making the clearcut attractive to hunters and berry pickers. As another example, surface runoff from a newly constructed, unstabilized forest road will cause some turbidity and sedimentation of streams, with a short-term adverse effect on fishing success and water sports. The same road may provide access for hunters, berry pickers, rockhounds, bird watchers, and campers.

Setting aside these often subtle distinctions, timber management practices usually result in adverse public reaction, particularly in areas of heavy recreational pressure (usually near population centers); in situations involving unique or rare ecosystems or scenery; and where natural attributes create a high recreation potential. The recreation may be justified in that timber management, particularly harvesting practices, will most often destroy the values or uses which the public is seeking. The apparent destruction of the forest and the accompanying activities in the form of logging truck traffic, chainsaws, road building, etc., represent both realistic and psychological adverse impacts on recreational values. If timber management practices went unchecked throughout the forest, many of its recreation values would be significantly impaired or destroyed.

e. Grazing

Implementation of some of the proposed practices can deny the use of Federal range to some permittees and lessees, temporarily or permently, however, grazing is extremely limited on the forested lands.

- Area burning of a forest range after clearcutting will consume grasses and animals, and often browse, thus temporaily eliminating or reducing available livestock forage. When seeding or planting the forest after burning, it may be necessary to exclude livestock from the treated area for several years, to permit the new stand of trees to develop without exposure to animal damage. A more far-reaching administrative decision may exclude livestock from the treated area permanently, on the grounds that timber values are too great to risk the effects of browsing and soil compaction that livestock can cause.

- Chemical weed and brush control might require that livestock be removed from the area to be treated prior to herbicide application. Their return might have to be temporarily deferred until chemicals have degraded to safe toxicity levels or, if the area treated is to be reforested, exclusion of livestock may be long-term or permanent.
- Various cutting practices (particularly clearcutting) can create more livestock forage. However, grazing may conflict with the silvicultural objectives chosen for treated areas, so that livestock must be excluded.
- Roads built for log transportation may impair a livestock producer's full utilization of allotted Federal range or of his own private lands. Log truck traffic can injure or kill domestic livestock.

Conflicts between timber management and livestock grazing will be most significant in the Montane Sub-biome. Short-term or permanent losses of forage and other impairment of range livestock operations attributable to the timber management program are insignificant in the overall production of meat to satisfy national needs. However, these adverse impacts may be highly significant to the individual livestock producer.

f. Agriculture

Where agricultural land uses involving row crops or orchards are located near timber management activities, some adverse effects could result. Aerial application of chemicals for weed and brush control in forest development activities could drift and settle on adjacent agriculture. However, the occurrence of agricultural lands adjacent to forest lands is virtually nonexistent.

Practices that disturb the soil, causing erosion and stream sedimentation, such as scarification, land clearing and cleaning, area burning, log skidding, and road construction can have adverse impacts on downstream agriculture dependent upon the forest watershed for irrigation water. Silt can fill downstream reservoirs, shortening their life, enter and clog irrigation systems, and harm crops when deposited on the fields.

Clearcutting and other harvesting practices, on the other hand, can also increase available downstream water by opening the canopy. This can allow increased accumulation of snow, reduce precipitation losses due to the interception by the forest canopy and evaporation therefrom, and reduce soil moisture losses caused by transpiration of vegetative cover.[88-91]

g. Commercial, Residential and Industrial

Adverse impacts that affect human settlement in general were discussed under Human Settlement. There are, however, a few other instances where timber management practices would adversely affect commercial, industrial, or residential land uses.

Roads construction across private lands for log hauling purposes would create nuisance-type impacts such as increased traffic, noise, dust, etc., if located near human dwellings. Furthermore, previously inaccessible private lands may be subjected to trespass and vandalism by the public.

Timber management operations carried on adjacent to private residential areas or commercial developments, such as ski resorts and recreational subdivisions, could lead to conflicts because of their impact on the senses of sight, sound, and smell.

h. Local Government and Public Services

Timber management practices can have direct and indirect adverse impacts on state and local government operations and planning. Physical disruption of public services such as gas, electric, and water facilities can happen where utility rights-of-way cross timber management areas. State and county roads and bridges can be affected by increased log truck traffic, leading to increased maintenance costs to local governments. Development of transportation systems related to timber management operations could conflict with local government plans and objectives. Where roads cross or pass close by state and local government lands, the lands may be subjected to increased public use.

10. Impacts on Aesthetics and Human Interest

a. Aesthetics

With few exceptions, the impacts of timber management practices on aesthetic values are adverse. Impacts of greatest magnitude are visual, but sound, odor, and mood are also involved.

(1) Visual Impacts

Any action that produces a visible change in the natural forest environment can cause an adverse human reaction.

ment actions with highly visible effects are prescribed burning of slash (atmospheric smoke, charred forest floor); scarification (dust during the operation, disturbance of surface vegetation and soil); chemical weed and brush control (dead vegetation); and precommercial thinning (slash). Noticeable evidence of protection actions includes fire lines and, if identified as such, the burned areas resulting from backfiring.

Cutting practices and logging operations are attracting increasingly critical public notice. Clearcutting in particular has been condemned by some groups, largely because of the visual impact of extensive poorly-designed clearcut areas. Some logging operations, and particularly subsidiary road construction, create visible soil disturbance and atmospheric dust. The soil disturbance alone may be visually objectionable; it can also be the source of sediment which, carried in surface runoff, spoils the clarity and color of natural waters. Heavy log truck traffic over dirt or gravel roads may create clouds of dust which seriously impair visibility.

Any of the timber management activities may leave such residual litter as discarded tools or equipment accessories (e.g., broken shovels, axes, wire-rope chokers and worn-out truck tires), empty fuel or herbicide containers, lunch wrappers, etc. as evidence of human presence on the land.

Consciously or subconsciously, most people have some appreciation of natural beauty. Reaction to the unsightly effects of timber management actions will vary in intensity with the individual viewer. The range of human attitudes does not lend itself to a discrete classification on a graduated scale. However, some group reactions can be considered generally typical:

- Members of a community dependent on a forest-based industry are more inclined to accept the adverse visual impacts of timber management actions.

- Hunters, fishermen, rockhounds, berry pickers, family-type campers, and off-road vehicle enthusiasts usually appreciate the easy access to the back country provided by logging road networks. This appreciation may or may not outweigh the individual's objections to unsightly conditions created by forest development and timber harvesting activities. Emotions may be mixed.
- Backpackers and wilderness advocates usually prefer the forest environment in its original condition, without man-made modifications. These people may react most strongly to any unnatural change in the landscape. They often oppose proposed roads which would open back country areas to vehicular travel.

The adverse visual impacts of timber production are partially offset by some incidental visual benefits. Sometimes logging road construction opens up an impressive scenic vista which otherwise would be unappreciated. Clearcutting and vegetative erosion control measures produce forage which attracts wildlife for easy viewing by amateur naturalists or for sport purposes such as hunting.

(2) Sound, Odor, and Mood

Even gregarious campers would tend to avoid proximity to a noisy logging operation or mechanized forest development project. Certainly a hunter would avoid such a locale; a fisherman seeking mental relaxation would, too. The diesel fumes and dust from such operations would be unpleasant to most recreationists. The combination of sound and odor or even the awareness of an odorless and soundless activity could shatter the mood of the soul-seeking wilderness advocate.

b. Geological Human Interest Values

Areas containing unique geologic structure occur in both the Montane and Northwest Coastal Coniferous Forests. While most actions related to timber management would have little if any adverse effects, road construction could have a severe impact on these natural features. Excavation of earth and rock during construction could irreparably alter natural arches and caves, ruining their visual quality.

Severe alteration of the vegetative cover, such as by clearcutting and brush removal, can also create ill effects on visually important geologic features.

c. Impact on Archeological Human Interest Values

Archeological sites and objects are most valuable to the scientist, educator, and recreationist when left undisturbed. From a scientific standpoint, archeological values are important primarily through their undisturbed relationship with other cultural or site features.

Timber management practices can destroy or disrupt archeological sites that are on or eligible for this National Register and also those that are of non-National Register significance but have recreational and other cultural values. Any action that disturbs the ground surface can have a direct impact on cultural resources and thus has a potential for destroying or disrupting when such actions include, but are not limited to road construction, logging, and scarification. Furthermore, the construction of roads can provide ready access to vandals and looters.

d. Historical Human Interest Values

Many old cabins, stagecoach rest stops, abandoned mining camps, and other historical features lie scattered throughout the Coniferous Forests. Remnants of old wagon trails occur in most of the Coniferous Forests. Severe disturbance or alteration of the vegetation near historic sites will disturb the visual setting and weaken their human interest values. Soil disturbance or alteration of the landscape by road construction, and site preparation for revegetation of cut-over areas can obliterate old trail remnants. Road access into historic sites can subject them to vandalism.

e. Cultural, Ethnic, and Religious Values

Impacts on the life styles of inhabitants of the Coniferous Forests create perhaps the most significant, cultural effect, and the most difficult to evaluate. Older cultures, represented by the Indians of the Taiga, Montane, and Coastal Coniferous Forests, may find employment in timber related activities to supplement their incomes. The cultural values of these native Americans are frequently in sharp contrast to those of loggers and millworkers. Confronted with such great contrast in values, the older culture may be drawn in the direction of the younger, usually more affluent one.

A more recent sub-culture has sought satisfaction and fulfillment in the solitude of the mountains and forests of the Montane and Northwest Coastal Forests. Forming family groups and adopting the life styles of rural America during pioneer times, the counter-culturalists are offended by any alteration of the natural forest ecosystem.

11. Impact of Wildfire

Wildfires do not constitute a planned action of timber management and while their primary cause is lightning on the western forests, their cause is sometimes directly attributable to practices carried out under timber management. These may include prescribed burning practices which go out of control, faulty equipment, carelessness, and other accidental causes. Consequently, the impacts of some wildfires must be recognized as a undesirable by-product of timber management.

A forest fire does a number of specific things. First, and perhaps most obviously, it consumes woody and other vegetative material. Second, it creates heat effects, as a result of which living vegetation and animal life are killed or damaged and often the soil altered. In most forest, much more is killed, injured, or changed through heat effects than is consumed. Third, it removes nutrients and produces residual mineral products that may cause chemical effects, mostly important in relation to the soil. A wide range and series of effects may result from these actions of fire. Some may be immediate and readily apparent, and some may be delayed and difficult to detect. Fire brings about various changes in the forest through physical, biological, and chemical means that may cause a whole sequence of effects on the ecosystem.

With the foregoing general description of the unmitigated impacts of wildfires on the environment as a background, no further attempt will be made to identify the specific impacts on each environmental component in this section. Since burning is used as a management tool in carrying out certain development practices, the unmitigated impacts, both beneficial and adverse, are described in detail in the appropriate sections of this chapter. The only distinction to be made is that quite often the magnitude of the impact is much greater in the case of wildfires when vast areas are affected. The unmitigated impacts of the on-the-ground measures employed to control and suppress fires are described under the Protection phase for each environmental component.

Bibliography

1. Bormann, F. H., and G. E. Likens, The Watershed-Ecosystem Concept and Studies of Nutrient Cycles, The Ecosystem Concept in Natural Resource Management, Academic Press, N.Y., 1969, pg. 74.

2. Brown, G. W., The Alsea Watershed Study, Vol. XXXII, Pacific Logging Congress 1972 Loggers Handbook.

3. Cain, S., Biotope and Habitat, Future Environments of North America, The Natural History Press, N.Y., 1966, pg. 53.

4. Soil Erosion and Water Pollution Prevention, National Association of County Engineers Action Guide Series, Volume XII, pg. 24-32.

5. Sowers, G. B., and G. F. Sowers, Introductory Soil Mechanics and Foundations, The Macmillan Company, New York, 1961, pg. 317-344.

6. Environmental Guide-Northwest Timber Operations, Crown Zellerbach Corporation, July 1971.

7. Ritter, Leo J., and Paquette Radnor, Highway Engineering, The Ronald Press Co., New York, 1960, pg. 231-249.

8. Brown, George W., Dr., The Alsea Watershed Study, (Reprinted from Vol. XXXII, Pacific Logging Congress Loggers Handbook, 1972), pg. 2.

9. Fredriksen, R. L., Erosion and Sedimentation Following Road Construction and Timber Harvest on Unstable Soils, U.S. Forest Service Research Paper PNW-104, 1970, pg. 1-15.

10. Brown, George W., Dr., Logging and Water Quality in the Pacific Northwest, (Reprinted from Watersheds in Transition, the proceedings of a national symposium sponsored by the American Water Resources Association and Colorado State University, 1972), pg. 330-334.

11. Brown, The Alsea Watershed Study, pg. 3.

12. Fredriksen, R. L., Comparative Chemical Water Quality - Natural and Disturbed Streams Following Logging and Slash Burning, (Reprinted from the proceedings of a symposium on Forest Land Uses and Stream Environment, presented by Oregon State Univ., October 19-21, 1970) pg. 125.

13. Leyno, Al and Jack Rothacher, Increases in Maximum Stream Temperatures After Slash Burning, U.S. Forest Service Research Note PNW-110 (August 1969), pg. 1-7.

14. Debano, L. F., J. F. Osborn, J. A. Krammes and John Letey, Jr. Soil Wettability and Wetting Agents, U.S. Forest Service Research Paper PSW-43 (1967), pg. 1-13.

15. Debano, Leonard F., Formation of Non-Wettable Soils Involves Heat Transfer Mechanism, U.S. Forest Service Research Note PSW-132 (1966), pg. 1, 2.

16. Rice, Raymond M. and Joseph F. Osborn, Wetting Agent Fails to Curb Erosion from Burned Watershed. U.S. Forest Service Research Note PSW-219 (1970), pg. 1.

17. Lotsperich, Frederick B., Ernst W. Mueller and Paul J. Frey, Effects of Large Scale Forest Fires on Water Quality in Interior Alaska, Federal Water Polution Control Administration, (College, Alaska; February 1970), pg. 1-86.

18. McKee, Jack Edward and Harold W. Wolf, Water Quality Criteria. Second Edition, California State Water Resources Control Board Publication No. 3-A (April 1971), pg. 355.

19. Juntunen, Erland T., and Logan A. Norris, Field Application of Herbicides - Avoiding Danger to Fish, Agricultural Experiment Station - Oregon State University, Special Report 354 (April 1972), pg. 2.

20. Norris, Logan A., and Duane G. Moore, The Entry and Fate of Forest Chemicals in Streams, (Reprinted from the proceedings of a symposium on Forest Land Uses and Stream Environment, presented by Oregon State University, October 19-21, 1970), pg. 147.

21. Norris and Moore, pg. 152, 153.

22. Ibid., pg. 153.

23. Tarrant, R. F., and L. A. Norris, Residues of Herbicides and Diesel Oil Carriers in Forest Waters: A Review, (Reprinted from the proceedings of a symposium on Herbicides and Vegetation Management in Forests, Ranges and Noncrop Lands, presented by Oregon State University in 1967), pg. 94-102.

24. Norris and Moore, pg. 148.

25. Norris and Moore, pg. 148-150.

26. Burroughs, Edward R., Jr., and Henry A. Froelich, Effects of Forest Fertilization on Water Quality on Two Small Oregon Watersheds, BLM Technical Note - Portland Service Center (April 24, 1972), pg. 1-8.

27. Norris and Moore, pg. 146.

28. McKee and Wolf, pg. 364.

29. *Ibid.*, pg. 368.

30. *Ibid.*, pg. 369.

31. *Ibid.*, pg. 381.

32. *Ibib.*, pg. 382.

33. *Ibid.*, pg. 378.

34. *Ibid.*, pg. 384.

35. Norris and Moore, pg. 153.

36. Blahm, Theodore H., Walter C. Marshall and George R. Snyder, *Effects of Chemical Fire Retardants on the Survival of Juvenile Salmonids*, *Report to Bureau of Land Management* submitted by National Marine Fisheries Service, (December 1972), pg. 1, 2.

37. George, Charles W., *Literature Review* on effects of fire retardants on fish, Intermountain Experiment Station, unpublished draft, Missoula, Montana, (March 1971), pg. 3.

38. *Ibid.*, pg. 2, 13.

39. Blahm, Marshall and Snyder, pg. 11-14.

40. Levno. Al and Jack Rothacher, *Increase in Maximum Stream Temperatures After Logging in Old Growth Douglas Fir Watersheds*, U.S. Forest Service Research Note PNW-65, (October 1967), pg. 1-12.

41. Swanston, Douglas N., *Principal Soil Movement Processes Influenced by Roadbuilding, Logging and Fire*, (Reprinted from the proceedings of a symposium on Forest Land Uses and Stream Environment, presented by Oregon State University, October 19-21, 1970), pg. 36.

42. U.S. Dept. of Interior Federal Water Pollution Control Administration (now EPA), *Industrial Waste Guide on Logging Practices*, Portland, Oregon, February 1970, pg. 5, 6.

43. Brown, *The Alsea Watershed Study*, pg. 4.

44. Symposium proceedings, *Practical Aspects of Forest Watershed Management*, (Symposium sponsored by SAF and Oregon State University, March 29 and 30, 1966), pg. 33-35, 64 and 65.

45. McGinnies, William G., Andrew L. McComb and Joel E. Fletcher, Role of Watersheds and Forests in the Arid West (Reprinted from Aridity and Man, by American Association for the Advancement of Science, circa 1963), pg. 277-307.

46. Anderson, Henry W., Managing California's Snow Zone Lands for Water, U.S. Forest Service Research Paper PSW-6 (1963), 28 pages.

47. Rich, Lowell B., Managing a Ponderosa Pine Forest to Increase Water Yield (In Vol. 8, No. 2 of Water Resources Research, April 1972), pg. 422-428.

48. Industrial Waste Guide on Logging Practices, pg. 25.

49. Brown, Logging and Water Quality in the Pacific Northwest, pg. 331.

50. Industrial Waste Guide on Logging Practices, pg. 17-21.

51. Crown Zellerbach Corporation, Environmental Guide - Northwest Timber Operations, pg. 9 and 11.

52. Ibid., pg. 10.

53. Zon, Raphael, Climate and the Nation's Forests, in Climate and Man - Yearbook of Agriculture, Washington, D.C., U.S. Government Printing Office, 1941, pg. 478.

54. Zon, pg. 487-497.

55. Spurr, Stephen, H., Forest Ecology, The Ronald Press Company, New York, 1964, pg. 15.

56. Hall, J. Alfred, Forest Fuels, Prescribed Fire, and Air Quality, U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, 1972, pg. 1.

57. Ibid., pg. 1-40.

58. Cramer, Owen P., and James N. Westwood, Potential Impact of Air Quality Restrictions on Logging Residue Burning, U.S. Forest Service Research Paper PSW-64, 1970, pg. 1, 2.
59. Hall, pg. 37-40.

60. Bever, Dale N., Evaluation of Factors Affecting Natural Reproduction of Forest Trees in Western Oregon, Oregon State Board of Forestry Research Bulletin No. 3, December 1954, pg. 1-49.

61. Clark, M. B., Direct Seeding Experiments in the Southern Interior Region of British Columbia, B.C. Forest Service Research Note No. 49, 1969., pg. 1-10.

62. Hallin, William E., Soil Surface Temperatures on Cutovers in Southwest Oregon, U.S. Forest Service Research Note PNW-78, April 1968, pg. 1-17.

63. Gratkowski, H., Brush Problems in Southwestern Oregon, U.S. Forest Service, PNW Experiment Station, Portland, Oregon, January 1961, pg. 3-7.

64. Spurr, pg. 185, 186.

65. Zasada, John C., Guidelines for Obtaining Natural Regeneration of White Spruce in Alaska, U.S. Forest Service, PNW Experiment Station, Portland, Oregon, 1972, pg. 1-15.

66. Youngberg, C. T., Silvicultural Benefits from Brush, (Reprinted from proceedings, Society of American Foresters, Detroit, Michigan, 1965), pg. 55, 56.

67. Zon, pg. 479-491.

68. Alexander, Robert R., Partial Cutting Practices in Old-Growth Lodgepole Pine, U.S.D.A., Forest Service Research Paper RM-92, June 1972.

69. Barrett, John W., Regional Silviculture of the United States, Ronald Press Company, New York, 1962.

70. Dryness, C. T., Soil Surface Condition Following Tractor and High-Lead Logging in the Oregon Cascades, Journal of Forestry, April 1965.

71. Franklin, Jerry F., Natural Regeneration of Douglas-fir and Associated Species Using Modified Clear-Cutting Systems in the Oregon Cascades, U.S.F.S. Research Paper PNW 3, September 1963.

72. Gratkowski, H., Brush Problems in Southwestern Oregon, U.S.F.S. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon 1961.

73. Pfister, Robert D., Habitat Types and Regeneration, Paper presented to the Reforestation Coordinating Committee of the Western Forestry and Conservation Association, Seattle, Washington, December 6, 1972.

74. Ronco, Frank, Solarization - A High Elevation Problem, Paper presented to the Reforestation Coordinating Committee of the Western Forestry and Conservation Association, Seattle, Washington, December 6, 1972.

75. Ruth, Robert H., Silvicultural Effects of Skyline Crane and High-Lead Yarding, Journal of Forestry, April 1967, pg. 251-255.

76. Smith, David M., Applied Ecology and The New Forest, Joint Session Proceedings of Western Forest Fire, Rest and Reforestation Coordinating Committees, Vancouver, British Columbia, December 1, 1970.

77. Smith, David M., The Practice of Silviculture, Seventh Edition, 1962. pg. 389-513.

78. Strothmann, R.O., Douglas-fir Reforestation on Severe Sites in Northern California, Paper presented to the Reforestation Coordinating Committee of the Western Forestry and Conservation Association, Seattle, Washington, December 6, 1972.

79. Williamson, Richard L., Shelterwood Harvesting: Tool for the Woods Manager, Pulp and Paper, January 3, 1966.

80. Youngberg, C. T., Silvicultural Benefits from Brush, Society of American Foresters, Detroit, Michigan, 1965.

81. Zasata, John C. and Robert A. Gregory, Regeneration of White Spruce With Reference to Interior Alaska, U.S.D.A. Forest Service Research Paper PNW-79, 1969.

82. Anderson, R.F., Forest and Shade Tree Entomology, John Wiley & Sons, Inc., 1960.

83. Brown, E. R., The Blacktailed Deer of Western Washington, published by Washington Department of Game, 1961.

84. Harper, J. A., Ecology of Roosevelt Elk, published by the Oregon Game Commission, 1971.

85. Anon., Trees and Deer, published by Oregon Game Commission, 1968.

86. Wright, E., and R. F. Tarrant, Microbiological Soil Properties After Logging and Slash Burning, Research Note No. 157, PNWFRES, Forest Service, U.S.D.A., December 1957.

87. Phillips, Robert W., Effects of Sediment on the General Environment and Fish Production, Symposium on Forest Land Uses and Stream Environment, Oregon State University, August 1971.

88. Symposium proceedings, Practical Aspects of Forest Watershed Management, (Symposium sponsored by SAF and Oregon State University, March 29 and 30, 1966), pg. 33-35, 64 and 65.

89. McGinnies, William G., Andrew T. McComb and Joel E. Fletcher, Role of Watersheds and Forests in the Arid West, (Reprinted from Aridity and Man, by American Association for the Advancement of Science, circa 1963), pg. 277-307.

90. Anderson, Henry W., *Managing California's Snow Zone Lands for Water* U.S. Forest Service, Research Paper PSW-6, 1963, 28 pg.

91. Rich, Lowell B., *Managing a Ponderosa Pine Forest to Increase Water Yield*, (in Vol. 8, No. 2 of Water Resources Research, April 1972, pg. 422-428).

IV. MITIGATIVE MEASURES TO BE FOLLOWED IN TIMBER MANAGEMENT

Many mitigative measures set forth in this chapter are initially brought to bear during the land use and timber management planning process, as described previously in Chapter I. Later, these and other measures are carried out in the course of planning a practice and in executing it through contract stipulations and contract administration. The stipulations available for inclusion in a contract are set forth in Appendix A, along with a sample timber sale contract as Appendix B.

The effectiveness of all of the measures described in this section is dependent upon sound planning, adequate man power and funding coordination with other resource activities, professional expertise, careful on-the-ground administration and cooperation from the contractor or user. Since these requirements are common to all mitigative measures they will not be repeated in the parts that follow.

The mitigative measures, most of which are currently followed, will be presented on a component by component basis, i.e., soil, water, vegetation, etc. However, since quite often the same mitigative measures apply to more than one environmental component, the emphasis is describing the measures will be placed on the most critical component impacted by the action in order to minimize redundancy.

It should be pointed out to the reader that although the language in this chapter as it relates to mitigative measures is written as a document of fact, situations will occur where alternative land uses, resource programs or activities conflict and are unreconciable. Consequently, in some instances the ensuing management decision may favor timber production resulting in the mitigative measure specified in this chapter to be subjugated to overall national priorities and needs.

Mitigative measures for all timber management practices shall be carried out so as to meet the requirements of the O&C Act, Federal Water Pollution Control Act, Clean Air Act, Fish and Wildlife Coordination Act, Bald Eagle Protection Act, Sikes Act, National Environmental Protection Act, National Historic Preservation Act, Historic Sites Act, Federal Environmental Pesticide Control Act and other applicable laws.

A. Ecological Interrelationships

The mitigative measures individually described for each component of the environment in this section represent, collectively, the actions to be taken in mitigating the impact of the timber management program on the ecosystem of lands classified as available for timber production. Consequently, they will not be restated in this part. Many practices identified as part of the program are in themselves mitigative in preventing or restoring any ecological imbalances or damage incurred in the course of carrying out practices which may be disruptive to the ecosystem. The former includes such practices as seeding and planting, and those that indirectly support these restoration efforts such as mulching and protection. Usually, the disruptive practices are those associated with the cutting, logging and transportation phases of the program whose mitigation is often a matter of where, when and how they are carried out.

B. Physiography, Geology and Minerals[1-4]

Forest Development

Many forest development practices are by their very nature mitigative in the sense that they decrease the potential for erosion and mass wasting. Tree improvement programs which increase growth rates and resistance to disease provide a means to rapidly achieve and maintain a protective canopy to preclude rain and wind erosion. Chipping adds material to the existing layer and reduces the effects of raindrop splash. Seeding and planting are both effective means to provide a vegetative cover which inhibits erosion. Planting, which is the prevalent reforestation practice, is the more desirable of the two methods because the tree is already developed and provides an immediate cover. Mulching provides a protective layer around individual trees and can be used as a means to inhibit erosive processes in the immediate vicinity of the tree.

Protection

Most practices carried out in this phase are also mitigative since they minimize or eliminate insect, disease, or fires which destroy the vegetative cover necessary for slope and soil stabilization.

Cutting Practices

Clearcutting and seed tree cutting practices are not to be employed on fragile areas having shallow soil mantles, generally 20" or less in depth, or on unstable underlying geologic formations in order to prevent massive erosion and soil movement. Rocky types and geologic structures will be examined in order to determine if they are conducive to mass movements for any type of cutting practice. If so, the land is not to be subjected to commercial timber production. As is the case in subsequent sections of this chapter clearcutting will be carried out in accordance with the procedures set forth in the report of the Federal Subcommittee on Public Lands on clearcutting on Federal timberlands.

Logging Methods

Logging methods which require a fewer number or miles of roads and trails are to be employed to the extent feasible in order to minimize erosion. Tractor logging is to be restricted to slopes 45 percent less and skidding operations limited to the time of year when the soil is relatively dry and stable.

Logging methods which would result in the least damage to the topography and surface material, in consideration of their attitude or orientation and the rock structure, are to be given first priority. Where deeply weathered pyroclastic rocks cover steep slopes, aerial systems are to be given first consideration, since these types are least conducive to mass wasting.

Transportation

Hard rock formations are to be utilized to the extent feasible as road beds. Slide potential can be lessened by choosing a location where the structural features including joints and bedding planes slope away from the excavation. To the extent possible, midslope road construction and the intersection of drainages should be avoided. Revegetation of critical cut slopes and fills is to be accomplished at the termination of construction activities.

C. Soils

Forest Development

Scarification is to be conducted when the soil is dry and limited to the area necessary to accomplish the task. Contoured strips or patches are to be used when feasible and all scarified areas revegetated as quickly as possible with desired species. Mechanical brush cutting is not to be conducted when soils are wet. Mechanical trenching-furrowing is to be conducted on the contour and the exposed soil immediately revegetated. Width should be kept to an absolute minimum and unstable areas are to be avoided. Burning shall not take place on shallow or soils particularly prone to erosion when conditions are such that a "hot" burn will consume all the litter layer. On critical sites, a mulch is to be applied to protect the surface from erosion until vegetation is re-established. Areas where burning would melt the permafrost are to be avoided. Any trenches for burying slash are to be constructed on the contour and the soil stockpiled and respread on the surface, after the trench is filled.

Hand clearing and cleaning are to limited to as small an area as possible to accomplish the task. A mulch is to be placed on the site in addition to an appropriate amount and type of fertilizer if critical soil conditions exist. Improper application and spills are to be avoided during chemical weed control and a cover of desired vegetation established as soon as possible. In precommercial thinning, care is to be exercised when gassing equipment or filling chemical injectors to prevent soil sterilization.

Protection

Fire lines are to be constructed on the contour when feasible and subsequently water-barred and revegetated where critical conditions exist. Hydromulch will be applied to provide immediate protection where needed to stabilize the soil. When critical, the fire line can be ripped to loosen compacted soil if the line also served as a trail for vehicles. Areas burned as a result of backfiring are to be revegtated as soon as possible after the fire. In the Taiga, fire lines are to be constructed in permafrost areas by hand trailing methods to the extent feasible.

Cutting Practices

Clearcutting, and to a lesser degree seed tree cutting practices, are not to be carried out on slopes where the potential for excessive erosion or mass wasting exists. Factors affecting slope stability which are to be considered include slope gradient, thickness of the soil mantle, character of the underlying bed rock, precipitation patterns, and the inherent strength of the soil. If these factors appear to be critical other cutting practices are to be considered. When these other practices, such as selection, shelterwood, etc., are not feasible due to silvicultural, economic, or technical constraints or the potential hazard remains despite the system of cutting employed, the area is to be exempt from commercial timber production.

Logging Methods

Tractor logging is to be limited to slopes with gradients of less than 45 percent regardless of the potential of the soil for compaction. Tractor skidding is not to be permitted down or across any stream channel. Tractor skidding is to be limited to those seasons and sites where soil moisture is low enough to avoid rutting or gouging of the soil. Operators are not to be permitted to clear a skid road for one or two trees. Following completion of tractor logging, skid roads are to water barred in order to minimize erosion. Since jammer yarding requires a closely spaced network of roads adverse impacts can be reduced by confining these operations to existing road systems, i.e., if new roads must be constructed alternative logging methods are to be used. In some instances jammer yarding may be accomplished by building roads on the snow. Landings are to be located so as not to create excessive sidecast or slope stability problems. After use, ripping will be carried out to mitigate any soil compaction that inhibits reforestation of the site. Cull logs are not to be decked at the edges of landings in order to reduce the potential for slope failure.

Transportation

Road alignment and design have important effects on roadside erosion and effective control must begin in the design phase since the location of a road determines to a large degree the amount of erosion which may occur. The selection of the road corridor provides the opportunity to place a road in favorable relationship to topography, drainage ways, soils, other natural features and present or anticipated man-made features in order to minimize the base erosion potential. Clearing and grubbing are to be conducted so as to minimize the area of soil disturbance and coordinated with grading so that ground disturbance due to grubbing will not be exposed longer than necessary. As is the case of most construction activities, clearing and grubbing are not to be carried out during periods of wet weather and poor soil conditions. To minimize erosion due to excavation, the total length of road cut is to be minimized, but the vertical depth of each cut is to be maximized in most instances. Thus, large quantities of material will be obtained at a single location. Cut slopes and ditch gradients are to be flattened in order to reduce the number of cuts, thereby reducing erosion hazard. Borrow areas are to be shaped to natural contours, fertilized and revegetated. Removal of the contour hump in a hill cut will decrease the erosion potential and make maintenance easier. Borrow pits are to be well drained unless suitable for pond development. If not, the topsoil is to be replaced and the area shaped, sloped, seeded, fertilized, and mulched.

Factors involved in the design of fills in embankment work are height, stability of slopes, stability of foundations, and the selection of embankment materials. All major fills (heights greater than 30-40 feet) are to be subjected to stability analyses and design in accordance with established principles of soil mechanics. Construction of embankments is to be done by placing the earth in layers and rolling to a specified density, usually in the range of from 90 to 100 percent of standard AASHO maximum density, before applying the next layer. As a result, the stability, or shear resistance of the soil will be increased, permeability or water entry decreased, and settlement of the embankment minimized.

During earthwork operations, areas of bare soil exposed to erosion are to be shaped to minimize storm runoff. Methods of control include such devices as silt basins, sedimentation ponds, berms and temporary down drains, swales, ditch pits, brush barriers, and other erosion control techniques. Drainage channels are to be constructed early in the grading operation. Ditches are to be kept cleared, culverts unplugged and drainageways open. Drainage is never to be allowed to dig its own channel. In preparing the surface for surfacing, the material is to be redistributed evenly, not scaped over the edge where it may erode into the established ditch. The road grade is to be established at least 5 feet above the water overflow level in wet areas and areas subject to overflow.

The procedures for erosion prevention in stabilization efforts include soil sampling for fertility, erodibility, and texture; correlation of results with the general soils survey; formulating mixes for fertilizing, liming, seeding, mulching, and slope dressing (generally topsoil) and provisions in design for any special problems. The desirability of topsoiling depends upon the quality of the subsoil involved and on the quantity and quality of topsoils available. Placement of topsoil over sterile subsoils will help innoculate the subsoils with micro-organisms at a faster rate than under normal conditions (by dust, debris, and flowing water). Plastic subsoils used as slope dressing over coarse or granular subsoils will help increase the moisture and nutrient-holding capacity of the soil, reduce soil-moisture loss, and reduce the erosion hazard. Equipment to be used for seeding should be either a hydroseeder or seed drill. Unless specific conditions warrant it, tractor-mounted cyclone seeders are not to be used. Hand operated broadcast equipment can be used in small inaccessible areas. The best time for seeding warm-season grasses is late spring and early summer, cool season grass in late summer or early spring, and legumes in mid-spring to mid-summer. Seeding in the semi-arid and arid regions is to be timed to precede the period of maximum probable rainfall. Other important practices available for turf establishment are tillage and seedbed preparation and mulching.

Ditch and flume liners of sod, rock, rubble, portland concrete, asphalt concrete, plastic or other materials are effective erosion stabilization devices. These liners are to be used for immediate erosion control on ditch bottoms, on shoulder slopes, on low side of curves, in backslope flumes, on fill slopes at culvert ends, on bridge abutment slopes, and on other areas subject to erosion by concentrated water flows.

In rock quarry development consideration is to be given to the use of larger pits and longer hauls instead of several small pits, thereby minimizing the erosion problems.

Bases and surfaces are to be constructed so as to prevent the entrance of excessive quantities of surface water into the base and subgrade from directly above. The base layer is to be free draining to prevent capillary action and frost heave. During surfacing operations excess oil application is to be controlled to avoid stream pollution at bridge crossings, etc. Care is to be excerised in picking a site for unloading the supply tankers into the distributor truck so that oil spills will not contaminate streams.

Soil around drainage structures must be protected from erosion to ensure the stability of the road structure and to prevent sediment from blocking the drainageway. Erosion in ditches will be controlled by providing a series of dams or weirs across the ditch to reduce flow velocity, so suspended matter will be deposited behind the checks. Various types of ditch checks can be made of concrete, stone, riprap, timber, steel and earth. Temporary checks of straw or hay bales are also used. Points where side ditches outlet into natural drainage are to be protected from erosion by such protective measures as a vegetated sluice or chute, paving, or an outlet structure. Where the roadway is in, cut interceptor ditches may be needed above the slope limits with flumes installed into the cut-slope face, or a combination of both, to prevent concentration of overland drainage from eroding the slope.

Across-the-road structures are to be placed as nearly as possible in line with the flow direction to enable a direct entrance and exit for the intercepted water. Use of short, right-angle culverts are to be avoided. Use of longer and skewed culverts to follow the natural drainage pattern will result in less maintenance cost even though initial installation costs will be higher. Energy dissipators or stilling basins are to be used at culvert outlets which pose an erosion problem. Bridges are to have adequate subsurface investigation to provide for stable abutments and sound footing locations. Activity in the streambed is to be kept to a minimum and performed during low water periods. Streambanks and protective vegetation are to be conserved.

The construction of roads on permanently frozen ground in the Taiga Forest could produce erosion and stability problems since the upper few feet of permafrost may thaw in the summer time and become a soft, soupy quagmire. Roads laid on permafrost is to be covered with an insulating blanket to minimize thaw, subgrades placed below the active zone to avoid movement, or the soil in the active zone replaced with a non-frost-susceptible material like gravel or coarse crushed rock.

In the maintenance of roads, surface drainage will be retained by performing proper maintenance grading and shaping and by patching and filling holes and irregularities. The surface is to be kept smooth, firm and free from excess loose material. Stabilization methods and dust palliatives and bituminous surface treatments are to be used to minimize loss of material and to eliminate as much as possible the hazards due to dust. Surfaces are to be reconditioned by scarifying and resurfacing when areas to be patched are numerous or extend over a considerable area. Bituminous surface treatments of a non-skid surface treatment. Care must be exercised to avoid spillage of petroleum products during refill operations and application areas controlled to prevent soil and water contamination.

Culvert inlets are to be cleared before and kept clean during the rainy season to diminish the danger of clogging and the possibility of washouts. Spur road s that outslope are to be cross drained and have berms removed on the outside edge except those intentionally constructed for the protection of road grade fills. Before spring runoff begins all ice and snow berms created on winter haul roads are to be removed. Gully erosion in waterways and ditch bottoms are to be repaired by filling, shaping and lining with riprap, juted or sodded materials. Culvert ends and bridge abutment slopes which have received concentrated water flows are to be stablized and repaired. All waste materials are to be deposited in stable bench or cover locations well above high water levels.

In general, bridge repairs include decks, railings, expansion elements and footings, bulkheads, etc., the latter of which may require some work in the bed of a stream. As in the construction of these facilities, activities in the streams are to be planned to coincide with low water. Tractors and other equipment operations in the streambed are to be minimized to cause the least aggravation to the streambed and stream banks.

Materials such as concrete, excess grout, form oil, etc., are not to be wasted in the stream. Approach fills and banks are to be stablized to prevent erosion and trash and debris removed upon completion of bridge site repairs.

Debris and slide material are to be end-hauled and deposited on a safe bench or cover location well above the high water level. Disturbed areas are to be shaped, tilled and seeded with deep-rooted legumes and grasses to hold the soil in place and fertilized and mulched or some other stablization practice used. Gravel drains are to be installed between topsoil and subsoil layers if needed to relieve water pressure and seepage.

The use of herbicides for controlling brush encroachment along road edges must be handled with care to avoid chemical drift and spillage problems which could contaminate streams. Mechanical brush cutters can be used in combination with chemical applications.

Erosion repair methods are comparable to measures taken in preventing erosion in the construction phase, however, a few variations do exist. Straw or hay may be disc-anchored or tacked with asphalt. Hydromulch (wood cellulose fiber pulp) is to be used on high steep slopes, rock overburden areas, or areas where the wood pulp is needed to "plaster" the seed and fertilizer in place. It can be applied with a hydroseeder along with seed and fertilizer. A wood excelsior blanket is recommended on slopes steeper than 2 1/2; 1 and longer than 25 feet. A blanket is to be used for establishing alfalfa and crown-yetch on difficult slopes and in the repairing of some gullies. Riprap (usually field stone) is effective for erosion control in culvert scour holes on shoreline slopes for protection from wave action, and in lining of waterways and channels. Soil compaction and surface disturbance is to be minimized by operating stablization equipment during favorable weather and soil conditions. Any temporary roads or trails are to be water-barred and if conditions warrant, seeded to vegetative species as soon as possible following their period of use.

D. Water

State water quality standards will be met in the course of carrying out any timber management practice.

Forest Development

The impact of area burning on water quality is to be minimized by minimizing the temperature of the burn, and by reducing overland flow from the burned area to the stream channel. The temperature of the burn is to be reduced by scattering the fuel and/or by burning under conditions which preclude high ground temperatures, such as burning immediately after a short rain shower. Overland flow from the burned area is to be reduced by completely covering the fire line, following burning, with the vegetative material that was removed during construction of the line, and by waterbars or check dams along the fire line.[5] Filter strips of undisturbed vegetation are to be left along the bottom of the area burned to filter some of the suspended solids from overland flow.[6] The width will vary with soil and slope characteristics. These filter strips also reduce the velocity of flow and cause deposition of sediment before it reaches the stream.

The adverse effects of scarification on water quality are to be reduced by (1) keeping machinery out of stream channels, both perennial and those that carry water during seasons of high runoff; (2) avoiding areas where slope instability will be increased by the removal of shrubs, tree stumps and roots; (3) avoiding the disruption of the normal distribution of water downslope; and (4) by scarifying along contours. Care is to be taken to leave enough small plants and plant debris to protect the soil from raindrop impact. Areas of shallow soils which can be easily stripped from underlying bedrock are to avoided. Soils which have a high potential for compaction by heavy equipment even during the dry season are to be excluded from scarification activities. Coarser textured soils are to be scarified during seasons when the soil moisture is low enough to reduce soil compaction. Heavy equipment is to be kept out of areas with high soil moisture to avoid creation of gouges and ruts.

Any practice that involves the use of pesticides shall be carried out in accordance with the Federal Environmental Pesticide Control Act of 1972 and applicable state laws. All proposed pesticide projects will be reviewed by the Bureau's Technical Pesticide Screening Committee and by the Federal Working Group on Pest Management for their approval or rejections. Chemical pesticides should not be used when non-chemical or integrated chemical and non-chemical techniques offer an alternative option. No pesticides will be used where there is a basis of belief that water quality will be degraded or hazards exist that will unneccessarily threaten fish, wildlife, their food chain or other components of the environment. At this time, the following pesticides are on the U.S.D.I. prohibited list and are not to be used: aldrin, amitol; arsenical compounds (inorganic), azodrn, bidrin, DDT, DDD(TDE), 2,4,5-T, dieldrim, endrin, heptachlor, lindane, mercurial compounds, strobane, thallium sulfate, and toxaphene.

In baiting and chemical weed and brush control practices, the proper combination of chemicals, carrier, method of application (ground or aerial), droplet size for spray applications, and width of stream side buffer strips is to be carefully evaluated to minimize the probability of accidental drift into streams, lakes, marshes, and estuaries. Air stability is essential for aerial applications and these practices are to be discontinued immediately when it appears that significant lateral drift may occur. Methods and areas for chemical mixing, storage, loading and cleaning of equipment are to be carefully selected to minimize the chance of leakage of chemicals into streams, lakes, reservoirs, marshes and estuaries. Empty chemical and carrier containers are to be disposed of carefully. Monitoring of streams and bodies of water is to be done prior to, during, and as long as necessary after chemical application to assure safe application.[7] There are circumstances which mitigate the water-quality degrading potential of the chemicals used in aerial baiting of rodents and in the treatment of aerially-disseminated seed. Poisoned wheat or oats which are commonly used in baiting rodents along with tree seed are more dense than the minute droplets which constitute the chemical sprays used in weed and brush control. Consequently, the baits and seeds are much less subject to lateral drift with moving air than are the chemical sprays, and hence less likely to miss the target area. The absence of petroleum-based carriers (commonly used with herbicides) is another circumstance mitigating the adverse impacts of baiting and seeding.

Finally, aerially disseminated baits and seeds are thinly scattered and do not cover the target area completely and uniformly as do sprays.

The potential adverse impact of forest fertilization on the water resource is to be reduced by the same precautions as with pesticides; that is, strict attention is to be given to streamside buffer strips and caution in storing, loading and applying the fertilizer.

Protection

The mitigative measures that apply to chemical weed and brush control also apply to the use of insecticides, fungicides and fire retardants. The mitigative measures employed in area burning, as described earlier, also apply to backfiring. In addition, the edge of a stream or lake is to be used to backstop a backfire only as a last resort. If time does not permit building a fire trail for the backfire, a road or natural break in topography may serve. Either is a preferable alternative to backfiring to the edge of natural water.

The impact of fire line construction on water quality is to be reduced by creating as little surface disturbance as possible during construction and by erosion control measures applied after the fire is controlled. Adverse impacts are to be mitigated by:

- Avoiding fire trail construction if control can be achieved by direct attack. Slow-moving ground fires can often be suppressed by swatting or by direct application of water.
- Building lines to a width no more than adequate to contain the fire, plus a realistic safety margin. Excessive construction is to be avoided. If manpower is adequate and hand tools will do the job, lines should be built by hand rather than by machines.
- Locating lines parallel to contours, if possible, and avoiding steep gradients.
- Applying erosion control measures wherever necessary to prevent surface runoff from carrying sediment and debris into natural waters. Waterbars and check dams are to be installed in fire trails to divert surface runoff and to reduce its velocity.
- Revegetating the burned area with suitable plant species as soon as possible after the fire is out.

These considerations are particularly critical in the fragile areas found in the Taiga Forest and the alpine zones of the Montane Forest.

Cutting Practices

The adverse effects of clearcutting and seed tree cutting are to be mitigated by:

- Providing streamside buffer strips of adequate width and density to reduce or eliminate sediment-laden overland flow from reaching stream channels. All perennial streams and those streams which carry water during peak runoff seasons are to have buffer strips. Buffer strips are to contain enough trees and shrubs to provide shade for the stream and protection for the stream bank. The width of the buffer strip necessary to meet these objectives will consider the slope of the ground into the stream channel; topographic shading; tree height, density, and species; stream characteristics (width, depth, and flow velocity); and the erodibility of the soil.
- Using other harvesting practices based on critical slope conditions. Factors to be considered are the effect of the loss of root strength on soil stability; slope gradient; thickness of the soil mantle; character of the underlying bedrock (smooth, fractured, etc.); precipitation patterns including the frequency of intense rainstorms; seasonally high ground water levels; and the inherent strength of the soil.[8]

Logging slash, cull trees, stumps, and other logging debris are to be properly disposed. Observations in western Oregon and Alaska have shown that logging slash left in steep, ephemeral stream channels contributes to the potential for destructive debris avalanches down these channels when soils become saturated during the winter season.[9] It is extremely important that debris be removed from stream channels concurrent with logging on the clearcut area. Channel clearance is not to be deferred until just before the timber sale contract is terminated.

Logging Methods

Falling timber unslope or along the contour of steep slopes will prevent felled trees from shooting downhill and into, or through, streamside buffer strips. Trees cut selectively adjacent to natural waters are to be felled away from the water. Logging slash and debris which enter stream channels or lakes unavoidably during falling operations are to be promptly removed.

Tractor skidding is to be limited to slopes with gradients of less than 45 percent regardless of the potential of the soil for compaction and not permitted down or across any stream channel, perennial or ephermeral. Tractor skidding is to be limited to those seasons and sites where soil moisture is low enough to avoid rutting or gouging of the soil. Operators are not to be permitted to clear a skid road for one or two trees since this practice results in areas crisscrossed with excessive skid roads. Following completion of tractor logging, skid roads are to be water-barred to minimize erosion. Since jammer yarding requires a closely spaced network of parallel roads to harvest timber from an area, adverse impacts are to be minimized by confining jammer operations to existing road systems.

In some instances jammer yarding can be accomplished with relatively little soil disturbance by building the roads on the snow.

In rough topography, aerial yarding systems are to be used wherever feasible, particularly on areas of unstable soils. Since aerial systems often operate more efficiently with road networks differing from those which serve conventional logging systems best, road location must be coordinated with the aerial logging plan.

On sites with slope stability problems, landings are to be located and their design specified to assure that the landing will not be overconstructed, that site productivity will not be lost by excessive sidecast, and that slope stability problems will not be created.

Transportation

Adverse impacts of road construction are to mitigated by:

- Designing the roads to minimum dimensions for the proposed use, consistent with traffic safety. If it is necessary to traverse short sections of unstable terrain, remedial measures (riprap, extra drainage, etc.) are to be included in the road design. Care is to be exercised to protect stream channels and banks by streamside buffer strips wherever possible. In the case of roads which approach stream crossings in narrow V-shaped canyons, the right-of-way clearing width may need reduction below the road to provide a vegetative strip for stream protection. The stream crossing itself is to be as narrow as possible, consistent with traffic safety. The stream channel is never to be used as a disposal site for excavated material from other portions or the road; often stream crossings become unacceptably wide because of this practice.

- Endhauling the excavated material if this will avoid long sidecast fills in steep terrain. Disposal sites for endhauled material are to be selected with care to avoid overloading slopes and causing mass failures. Fills are to compacted if this practice will contribute to slopes stability and prevent road failures.
- Installing culverts at frequent intervals to assure that the road subgrade will remain dry and stable. Drainage from culverts is never to be allowed to fall on unprotected fills. Aprons are to be installed on fills under culvert outfalls. Downspouts, or other suitable conductors are to be used to carry culvert drainage and to dissipate the kinetic energy of this water before allowed to run onto natural slopes.
- Constructing and installing bridges and culverts so that the streamflow is optimum for completing the required work with minimum degradation of water quality. Activities are to be planned to minimize the time that heavy equipment is in the stream channel. All activities necessary for construction and installation are to be planned and executed so as to result in the minimum amount of water quality degradation.

Appropriate stablization practices are to be taken to correct any incipient failure of a road or slope or to remedy any erosion of a road fill, road cut, or slope. Temporary roads and trails are to be waterbarred at the time of their abandonment to minimize the risk of any stream sedimentation resulting from soil erosion.

E. Air and Microclimate

Forest Development

Troublesome smoke from burning practices is to be minimized by integrating burning schedules with weather reports so as to produce as fast and hot combustion as practicable.[10] Weather forecasts are also to be utilized to keep smoke away from sensitive areas. Federal and State air quality standards are to be met in the course of any prescribed burning activities. Burying slash and chipping are to be used when feasible to reduce the volume of fuel and thus reduce the need for burning and the resulting smoke emissions. In many situations where prescribed burning or brush removal are essential, the impact on micro-climates may be non-existent or insignificant. If considerable impacts are anticipated, however, the following mitigation is to be accomplished by:

- Keeping the areas to be treated small. The growing trend toward smaller-size clearcuttings favors this means of mitigation, particularly in the case of area burning. The beneficial effects of partial brush cover, where desired, can be retained by spot removal rather than broad area treatment of brush.

- If a light burn will achieve silvicultural objectives, its application is to be timed for a period when burning conditions will favor an easily-controlled fire of low intensity. Fire equipment and manpower is to be put on standby status for emergency use in case burning conditions should change or if the fire escapes. When necessary, a fire trail is to built around the project area before treatment begins.

Protection

The adverse impacts of backfiring on micro-climates are to be mitigated by:

- Keeping the backfired area as small as feasible, consistent with the objective of controlling the wildfire.
- Backfiring if possible, when burning conditions will favor easy control.
- Safeguarding the backfire by burning from a road, fire trail or natural barrier.
- Maintaining adequate manpower and equipment on standby.
- Revegetating the burned area with suitable species as soon as possible.

Cutting Practices - Logging Methods

In the case of critical conditions where the site is dry and exposed to solar radiation and drying winds, cutting practices which provide shade to reduce surface soil temperatures and evaporation are to be used. In forests susceptible to windthrow, any clearcut area is to be designed to fit the topography so that strong winds will have a minimum effect on the edges of the reserve stand exposed by harvesting. No mitigation is necessary for the slight adverse effects of logging methods on micro-climate.

Transportation

The effect of right-of-way clearing upon the local climate is to be minimized by keeping the width of clearing as narrow as possible, consistent with safety and adequate visibility. No effective measures are presently available to reduce the short term degradation of air quality by the emissions of internal combustion engines used on road construction machinery. Dust arising from construction can be reduced to some extent by watering of subgrades during blading and surfacing operations. Aerial dust from log hauling by truck can be abated by oiling roads or surfacing them with bituminous material or macadam. On dirt or gravel surface roads, periodic application of water or waste sulfite liquor is to be carried out if critical dust conditions exist.

F. Vegetation

1. Terrestrial Vegetation

Forest Development

Mitigation of adverse short term impacts as a result of forest development treatments that destroy existing vegetation are to be achieved by confining practices to small areas, e.g., scarification in strips or patches, mechanical furrowing or trenching, spot burning, hand application of herbicides around individual trees, mulching, and hand clearing and cleaning.

Long term impacts associated with forest development actions such as scarification, area burning, and aerial spraying of herbicides are to mitigated by insuring that such actions result in environmental conditions favorable to tree regeneration on the specific site in question. This requires (1) an appraisal of environmental conditions on the site prior to the action, and (2) a basis for predicting environmental consequences of the action if applied to the site. These requirements are to be met by (1) classifying forest land according to plant associations,[11] or habitat types,[12] and forest soils,[13] and (2) applying appropriate forest development actions to selected classes and monitoring results.[14] Adverse long term impacts, in terms of stands potentially susceptible to insect and disease infestations, from tree improvement is to be avoided by adhering to statistical and genetic guidelines relative to numbers of trees selected per breeding unit for breeding purposes.[15]

Protection

In order to minimize the short term impact of fire lines and backfiring, as little vegetation as possible is to be destroyed, without jeopardizing the objectives of the actions. When feasible, fire lines are to be constructed along contour lines to minimize the indirect impact of erosion on vegetal life and growth. Burned or disturbed areas are to be artifically revegetated as soon as possible with herbaceous and/or tree species when natural regeneration cannot be reasonably expected in a short period of time. Most of the practices associated with protection, i.e., insect, disease and fire control, are in themselves mitigative since they are primarily aimed at maintaining the health and vigor of the vegetal component of the forest.

Cutting Practices

Mitigation of long term adverse impacts resulting from timber harvest practices is primarily a matter of insuring that the cutting practice used is one that will result in environmental conditions favorable to tree regeneration on the specific site in question. As with forest development, land classification and a predictive system are needed to insure these results. In the absence of such information, however, long term adverse impacts are to be mitigated by (1) confining clearcutting and seed tree cutting to sites where experience has shown that the practice can be expected to result in successful natural or artificial tree regeneration within two to three years, e.g., cool-moist sites in the Northwest Coastal Sub-biome and Douglas-fir and Western Hemlock zones of the Montane Sub-biome, (2) restricting size of clearcut and seed tree cuts to approximately 40 acres or less, and (3) using selection or shelterwood cutting elsewhere, e.g., warm-dry sites in all vegetative zones, high elevation sites where intense light is detrimental to true firs.

Adverse impacts of windthrown trees along edges of clearcuts and throughout seed tree and shelterwood areas are to be mitigated by the early removal of hazardous concentrations. Windthrow in shelterwood cutting areas can be minimized by cutting small amounts of standing timber at frequent intervals rather than the opposite.

Logging Methods

Adverse short term impacts resulting from destruction of vegetation by logging methods are to be mitigated by using only those methods that result in minimum disturbance to understory, shrub and herbaceous layers, e.g., skyline, balloon and helicopter yarding. However, mitigation of long term adverse impacts resulting from the use of various logging methods, is, like development and cutting practices, a matter of insuring that resulting environmental conditions are favorable to tree regeneration on the specific site in question. Requirements are likewise the same, i.e., land classification and a predictive system. In the absence of such information however, adverse long term impacts are to be mitigated by using logging methods that disturb herbaceous and shrub layers (tractor or high-lead yarding) whenever (1) such layers are well developed beneath the overstory and do not contain adequate tree regeneration, (2) use of forest development actions to destroy vegetation is impractical, i.e., steep topography that precludes scarification, or fire hazard precludes area burning, and when (3) soil compaction or erosion will not occur.

Mitigation of adverse long term impacts resulting from use of minimum disturbance logging methods, i.e., skyline, balloon, and helicopter yarding, is to be accomplished by forest development actions that destroy vegetation, i.e., scarification, area burning, mechanical brush cutting and aerial application of herbicides. Where these measures are not feasible due to adverse impacts on other elements of the environment forest development actions such as hand clearing and cleaning, hand application of herbicides, and use of shade loving species of trees in tree planting, are to be considered.

Transportation

In general, both short and long term adverse impacts caused by road construction are to be mitigated by locating and engineering roads so as to avoid sidecasting. Specific recommendations for mitigating adverse impacts on soil are also applicable to mitigation of adverse impacts on vegetation.

2. Aquatic Vegetation[16-21]

Forest Development

Adverse impacts of forest development actions such as mechanical brush cutting, area burning, snag felling, and chemical application of pesticides are to be minimized by leaving untreated buffer strips between treated areas and streams. The width of the buffer strip will vary with the practice employed in order to preclude the entry of soil, organic matter or toxicants into the water. Any algae blooms, or growth of undesirable aquatic plants in lakes or ponds resulting from accidental drifts during fertilization are to be controlled by use of appropriate herbicides.

Protection

Adverse impacts of protection practices are to be minimized by insuring that insecticides and other chemicals are confined to the target area; i.e., all possible techniques for minimizing drift and guarding against accidental spills are to be employed. When feasible, bodies of water are not to be used as natural fire lines. The impacts of fire lines are to be reduced by constructing them along the contour away from streams or lakes, when feasible.

Cutting Practices - Logging Methods

Adverse impacts of cutting practices and logging methods on aquatic plants are also to be mitigated by use of a buffer strip between the cutting area and stream. Any trees, slash or large debris that reach the stream, or its vicinity, during the logging operation are to be removed. If logs must be yarded across important perennial and intermittent streams, use of logging systems capable of suspending logs above the buffer strips; e.g., skyline, balloon, or helicopter yarding, are to be used. Their use on steep slopes and erodible soils will also minimize the impact of siltation on aquatic vegetation.

Transportation

Adverse impacts of road construction on aquatic plants are to be mitigated by leaving a buffer strip of heavy or dense vegetation between roads and streams. The width of the buffer strip will vary principally with slope, soil type and the nature of the vegetative cover. Other effective measures include (1) location of road away from the aquatic habitat or areas of unstable soils, (2) engineering roads to prevent sidecasting, (3) water barring unsurfaced (dirt) roads, and (4) stabilizing roadside cuts and fills and culvert installation points by seeding herbaceous vegetation.

Adverse impacts from road maintenance actions are to be mitigated by (1) hauling soil and debris from landslides to suitable disposal sites and (2) leaving an effective buffer strip between roadside spraying areas and the aquatic environment.

G. Animals

1. Terrestrial Wildlife [22-26]

Forest Development

Loss of habitat due to tree improvement, and other practices that materially increase the growth cycle of conifers, will be compensated for by the proper spacing, size of cutting, and rotational age of cutting to assure a continuing chain of regenerative age classes.

To mitigate adverse impacts of scarification, mechanical brush cutting, burning and chemical weed control, surface cover destruction is to be restricted to small areas to allow displaced wildlife a chance to move to adjacent available habitat. Brush removal is to be avoided on big game winter ranges, calving and fawning sites. While regulations prohibit the general use of poisons such as endrin, and "1080" for

for rodent baiting and tree seed treatment, clearance has been received for the use of strychnined-salt blocks for porcupine control. These blocks are to be placed in specially designed metal bait stations. Any other approved baits are to be placed underground, in runways, or in other protected sites where a degree of protection can be provided non-target species. Carcasses of poisoned animals are to be burned or disposed of to protect carrion-feeding predators from effects of secondary poisoning. (Refer to the section on soils for further information on pesticide use.) Adverse impacts of baiting can be totally avoided by using the alternative of fencing and screening to protect conifers from seed and seedling destroying animals. As a result of current research projects designed to (1) find a chemical seed protectant as an alternative to endrin, and (2) protect tree seed by masking its odor; the use of poisons may become unnecessary in the near future.

Adverse impacts of fencing are to be mitigated by making enclosures completely deer and elk-tight to preclude their entry and entrapment; the smaller the enclosure, the less chance of larger animals gaining entry. Another mitigative measure is to avoid use of fences on big game migration routes, calving or fawning areas, or in sites of intensive hunting. Since antlered animals are easily entangled and killed in nylon mesh, mitigation is to be achieved through use of conventional wire fences. Mitigation of adverse impacts from snag felling is to be achieved by reserving high quality snags (with regard to wildlife use) in selected locations. Eagle and osprey nest tree preservation sites are also to include adjacent dead trees and snags used for perching by both young and adults. Preservation of snags, flat tops, spike tops and other dead and dying trees, by wildlife considered endangered, are to receive highest consideration. If important snags or dead trees cannot be saved, the girdling of some live trees on the site for future wildlife use is to be considered. Adverse impacts of precommercial thinning and pruning are to be mitigated by confining the actions to the time of year when human activity on the site will not preclude reproduction or wintering activities.

Protection

Adverse impacts of protection practices are to be minimized by isuring that insecticides and other chemicals are confined to the target area; i.e., all possible techniques for minimizing drift and guarding against accidental spills are to be employed. Before any control of insects and disease is initiated, a determination is to be made as to what non-target wildlife species are present and how they would be affected by proposed control methods.

Cutting Practices

To avoid adverse impacts to the greatest number of wildlife species, cutting, particularly clearcutting, is to be confined to small, scattered tracts ranging from 15 to 40 acres in size so as to produce the greatest "edge" effect in any general area. To avoid the short term impact of harvesting on nesting and wintering wildlife, falling and bucking, and yarding operations are to be done to the extent feasible at times other than the nesting season or months of severe winter weather.

Logging Methods

Areas denuded of vegetation as a result of tractor, high-lead or other ground systems are to be seeded to grass-legume-browse species best suited to a variety of wildlife in critical food shortage areas.

Transportation

Adverse impacts of transportation on terrestrial wildlife are to be mitigated by:

- Avoiding road use or construction during the nesting season or critical need season.
- Avoiding big game winter range or closing roads to travel during winter or critical need season.
- Closing spur roads when not necessary for timber management.
- Leaving vegetal screening cover along main roads through cutting areas.
- Keeping rights-of-way clear of vegetation along paved roads to minimize opportunity for wildlife destruction by fast moving vehicles; use unpalatable species of vegetation for roadside stabilization and post signs warning of presence of wildlife.
- Locating and engineering roads to avoid sidecasting soil, rocks and debris, etc., down steep sideslopes.
- Designing cut banks along steep sideslopes to allow unrestricted animal movement up and down the slope.

2. Aquatic Wildlife[27-52]

Forest Development

Mitigation of adverse impacts caused by heavy equipment in scarification, and mechanical brush cutting are to be mitigated by

(1) confining their use to conditions that preclude soil compaction and erosion, e.g., gentle slopes with deep non-erodible, dry soils, (2) using an effective vegetative buffer between treated areas and streams, (3) water-barring and revegetating spur roads constructed during the operations, and (4) preventing machinery from crossing streams except over bridges or culverts.

Adverse impacts of chemical weed control are to be mitigated by avoiding direct application to standing or running water by establishing vegetative buffers between streams and treated area, especially where non-hand application methods are used. The width of the buffer strips will vary with the method employed, however, they are to be wide enough to insure that chemicals do not enter the waterway. The risk of accidental spillage of pesticides into streams is to be minimized by selecting "safe" routes for transport vehicles to travel and places to load aircraft. Impacts are also to be reduced by confining application to the target area and preventing drift of spray into adjacent areas. Drift is to be minimized by spraying only when air is calm and using (1) helicopters instead of fixed-wing aircraft, (2) invert emulsions where technically feasible instead of "conventional" methods, and (3) spray orifices that produce droplets least prone to drift by wind. Pilots thoroughly familiar with the area are least likely to make mistakes and spray off-target areas. (Refer to the section on soils for further information on pesticide use.)

Adverse impacts of fertilization are to be mitigated by avoiding direct application to standing or running water through use of buffer strips.

The use of an effective buffer strip between streams and the burned areas is also an important mitigative measure for area burning. Another means by which to avoid adverse impacts to aquatic wildlife is to confine area burning to gentle slopes and soils that are not erodable. Substitution of spot burning or chipping of slash is also effective mitigation if done away from streams and behind effective buffer strips.

Adverse impacts of baiting and seeding (where seeds are treated with toxic chemical repellants) and to be mitigated by (1) selecting chemicals least toxic to aquatic wildlife, including insects, (2) avoiding application over water, (3) using hand application methods where possible, (4) using helicopters instead of fixed-wing aircraft if aerial application is essential, and (5) using a buffer zone between the aquatic habitat and treatment area.

Other possible metigative measures include (1) avoid fencing across steams that support fish so as to preclude blockage by drifting debris, (2) avoid snag felling in buffer areas, or if it is necessary, fall them away from streams, and (3) avoid thinning or pruning immediately adjacent to streams.

Protection

The most effective mitigative measure for adverse impacts associated with use of pesticides is to restrict control activities to use of biological methods; i.e., parasitic predators and viruses. Where insecticides are used some effective mitigative measures include (1) selection of insecticide and rate of application least toxic to aquatic wildlife, including insects, (2) use of buffer zones between aquatic habitats and treatment area, (3) confinement of treatment to treatment area by using helicopters instead of fixed-wing aircraft, spraying only when air is calm and, if possible, using only pilots familiar with the treatment area, (4) using latest technology for producing a spray droplet spectrum that tends to fall rather than drift in air currents, and (5) carefully select transportation routes and loading sites to preclude spillage of insecticide into aquatic habitat. Precautionary measures similar to use of insecticides and chemical weed control are to be used to mitigate impacts from use of fire retardants. (Refer to the section on soils for further information on pesticide use.)

Cutting Practices

To minimize impacts on aquatic wildlife the cutting practices that are least destructive to terrestrial vegetation and soil are to be considered, i.e., selection cutting should be considered first followed by shelterwood, seed tree and clearcutting. Regardless of the cutting practice used, adverse impacts are to be mitigated by leaving buffer zones of effective vegetation between the aquatic habitat and cutting area so as to prevent increases in stream temperature, reduce sediment intake of streams, protect existing stabilized stream banks and retain character of the bottom. Impacts are to be further mitigated by not falling trees into streams.

Logging Methods

To mitigate adverse impacts, the logging method least destructive to soil and terrestrial vegetation; i.e., aerial methods such as skyline, balloon or helicopter yarding are to be first priority. A wide buffer zone of standing trees left along the aquatic habitat, may prevent up-slope trees from crashing into the stream during the falling operation. Trees nearer the stream are to be felled away from the buffer zone and stream. Streams are to be protected from mud and siltation by prohibiting yarding during periods of heavy rainfall. Logging debris that finds its way into streams or the immediate vicinity of streams is to be removed as a mitigating measure against stream blockage during periods of high water.

Other potential measures to be followed to mitigate adverse impacts on aquatic wildlife include (1) stabilization after logging, of all disturbed areas, especially skid trails and spur roads, (2) removal of all temporary structures from streams, (3) careful removal of fills at temporary stream crossing rather than allow high water to carry soil away, (4) use of sediment and debris traps and (5) limiting the season of logging.

Road Construction and Maintenance

Adverse impacts associated with road construction and maintenance are to be mitigated by the following measures:

- Locate roads away from the aquatic habitat; use suitable vegetative buffer for roads that have to be near streams.
- Locate and design roads so as to minimize sidecasting of soil, rocks and debris.
- Do not obtain road gravel from streams.
- Do not make stream channel changes.
- Riprap unstable banks along streams.
- Stabilize cuts and fills with drainage structures and fast growing herbaceous vegetation with good soil holding characteristics.
- Design and install culverts and structures that permit fish passage.
- Locate rock crushing and washing sites away from streams.

- Use road surfacing materials that will not erode during wet weather.
- Spill water from drainage culverts on stabilized areas only.
- Use adequate sized culverts and bridges (consider possibility of future timber removal above culvert or bridge site and impact on anticipated flows).
- Do no construction work during periods of heavy rainfall.
- Deposit soil and debris from landslides and endhaul in locations where erosion into streams will not occur.
- Leave a buffer of vegetation between roadside spray areas and the aquatic habitat.
- Minimize construction activities during critical need season.

3. Domestic Livestock

The adverse impacts of timber management practices, including cutting, logging and land treatment, are to be mitigated through proper coordination with the grazing management program on those areas designated for both uses; i.e., conducting these activities during the time the area is rested from grazing. In some cases, domestic livestock may have to be moved from specific areas during periods of intense activity in order to properly protect livestock from accidents and disturbance during timber harvesting and removal operations.

The amount of land taken out of production due to the construction of roads, trails and landings are to be minimized by limiting their dimensions and by constructing only those facilities necessary to meet management objectives. Existing facilities are to be used whenever possible.

After necessary work is carried out, rehabilitation and revegetation measures are to be undertaken on disturbed areas. Revegetation is to be accomplished as soon as possible after the areas are disturbed. Where applicable access such as roads and trails that are no longer needed are to be closed and revegetated to provide livestock forage.

The adverse effects of chemical weed control to domestic livestock are to be mitigated by selecting chemicals that will only effect plants of little importance for livestock forage. Possible detrimental effects to livestock themselves, either through treated vegetation or through direct exposure to chemicals, are to be mitigated by deferment of grazing on the treated areas. Adverse effects of fencing and screening on domestic grazing animals are to be mitigated by locating fences so they will facilitate the systematic manipulation of grazing animals to benefit vegetation and related resources.

H. Micro and Macro-Organisms

1. Soil Organisms

Since the nature of soil and soil organisms are so closely correlated, the mitigative measures for minimizing or eliminating the adverse impacts of timber management practices on soil, as described previously, apply also to soil organisms and will not be repeated.

2. Aquatic Organisms

Forest Development

Vegetative buffer strips adjacent to aquatic habitats are to be used to reduce adverse effects on aquatic life by the following actions: scarification, mechanical brush cutting, area or spot burning, chemical weed control, fertilization, snag felling, and baiting or seeding if seeds are treated with toxic chemical repellants. Soil erosion is to be minimized following scarification and mechanical brush cutting by revegetation of treated areas, and water barring of spur roads used during these activities.

During aerial seeding or application of pesticides and fertilizers, the use of helicopters is to be given preference to over fixed wing aircraft. Care is to be taken to prevent accidental spills of fertilizer or chemicals into waterways. Herbicides are to be used to control undesirable blooms of phytoplankton in lakes or ponds caused by fertilization.

Protection

Insecticides least toxic to aquatic life are to be used at the recommended rate of application. Use of a buffer strip adjacent to aquatic habitat helps minimize damage as does use of a helicopter during calm weather to reduce the possibility of drift. Care is to be taken to prevent fire retardants falling directly into streams or lakes.

Cutting Practices

The least amount of soil erosion results from the lightest cutting practices, i.e., selection or shelterwood cuttings. However, adverse impacts from all cutting practices are to be mitigated by buffer strips between the cutting area and stream or lake.

Logging Methods

Buffer strips are to be used to prevent most trees from entering the stream during falling and bucking. Any trees, logs, or debris that reach the stream during logging are to be removed concurrently with the yarding operation. Logging systems which cause the least amount of soil disturbance on steep slopes are to considered in order to minimize sedimentation of streams. Aerial systems which are capable of lifting logs clear of the ground and buffer strips are to be used if logs must be yarded across important streams.

Transportation

Refer to other sections of this statement for practices which mitigate adverse effects, particularly soil erosion, caused by road construction and maintenance.

I. Human Settlement and Land Use

The planning processes described in Chapter I are to be used to identify resource values and resolve conflicts. Where conflicts exist between two or more competing uses, they are to be reconciled through (1) adjustments in the timing or season of occurrence between conflicting uses, (2) adjustments in the relative intensity or level of use between uses, and (3) initiation of practices on the ground designed to minimize or avoid conflicts. If non of these are successful, then one or more conflicting uses must be eliminated for that planning area. The resolution of conflicts between land uses on the public lands and on adjacent non-Federal lands can be accomplished through coordination with local government planning bodies. Where these bodies are absent, or plans are inadequately enforced, conflicts may not be easily resolved.

In the following discussion on mitigation of impacts associated with timber management, reference will be made to land use planning as a mitigative measure where appropriate.

1. Human Settlement

Health and Safety. Where human inhabitants are living on or near lands where chemicals are to be used to control or remove brush and weeds, the impact on the health of these individuals is to be avoided by:

- Using only approved chemicals, applied at the minimum rate necessary to do the job.
- In the case of occupants on or in the immediate vicinity of the lands to be treated, timely notification of the intent to conduct aerial spraying and the date and time that it will be done.
- Using helicopter instead of fixed wing aircraft to minimize the risk of off-target application.
- Applying chemicals only when the wind is calm.

Chemicals are not to be allowed to enter streams and open bodies of water. Ill effects caused by smoke from slash burning are to be mitigated by burning on days when atmospheric conditions favor rapid rise and dispersal of smoke. All such burning is to be done in accordance with a smoke management plan. Where timber harvesting is permissible on municipal watersheds all practices shall be carried out in a manner that does not jeopradize the quality of water for human consumption. Quarrying and rock crushing activities are not to take place where inhabitants will be subjected to clouds of dust. In these instances alternate sources of quarry material and crushing sites away from inhabitants are to be utilized. Safety hazards associated with log trucks and the motoring public are to be minimized by proper road design, avoidance of blind curves, providing adequate turnouts for passing, and use of warning signs. Accidents and injuries involving timber harvesting and management activities are to be minimized by ensuring that employees receive adequate safety training, that they are thoroughly trained in their jobs, that they wear required safety equipment, and that they use the proper equipment, maintained in a good state of repair.

2. Mineral Development

The objections of prospectors and mining claimants to timber management practices can sometimes be overcome by personal contact. Assurance that the proposed action involves only the timber resource, with no real infringement of mineral exploration or development rights, will often be enough to allay the miner's suspicions and gain his cooperation.

3. Wilderness

Commercial forest lands unique in character are to be identified and evaluated for withdrawal as natural or primitive areas. This kind of foresight may be particularly valuable in planning for future development of the interior forests of Alaska. However, any implementation of timber management practices in the de facto wilderness areas of interior Alaska are to be deferred pending completion of land use planning.

4. Recreation

Developed and potential recreation sites are to be excluded from commercial timber production and screened by permanent vegetative buffer strips, with trees reserved from cutting. Occasional removal of danger trees may be necessary for user safety only; however, their removal is to be conducted during the period of least use, to the extent feasible. Sources of potable water supplying recreation sites are to be permanently protected from possible contamination by any timber management practices. Roads providing access to recreation sites are to be built to standards that permit both car and truck traffic to move safely. Sedimentation, scouring and mass soil movement is to be minimized by adequate vegetation buffer strips and proper road location and stabilization in order to protect waters utilized by fisherman, boaters and swimmers.

Since wildlife makes a major contribution to the quality of forest recreation, wildlife habitat is to be considered in planning for timber harvest. Adequate escape cover, bedgrounds, elk calving grounds, etc., are to be reserved from cutting or subjected to special cutting practices in order to perpetuate resident species. Den trees or nesting trees are to be reserved to the extent feasible and seasonal restrictions set on logging operations to avoid harassment of wildlife during critical periods when the young are born and reared.

Extensive areas of high recreational values are to be subjected to special cutting practices if these values would be impaired by normal practices. Cutting methods that detract least from a natural appearance are to be considered wherever possible. Continuous canopy management may perpetuate quality recreation in such areas. This is a system of modified shelterwood cutting wherein final removal of the overstory is deferred until regeneration in the understory is large enough to present a forest-like appearance.[53]

Mitigation of adverse effects on recreation is also to include repairs or reconstruction of any recreational facilities or improvements accidentally damaged during timber management operations. It is essential that all logging litter and junk on operating areas be removed and disposed of properly.

5. Grazing

As in the case of mineral development, contact with livestock producers can contribute to alleviating any conflicts between timber production and grazing. Timber management activities are to be coordinated with grazing management activities on those areas subject to both uses. When conditions warrant, cattle guards are to be installed and any other measures taken to protect or prevent livestock from straying off or onto public range along constructed roads.

6. Agriculture

Adverse impacts caused by chemical weed and brush control drifting from forest land onto nearby crop land are to be mitigated by using helicopter aerial application instead of fixed wing aircraft, buffer strips, and spraying only on calm days. Impacts on downstream irrigation reservoirs and facilities caused by siltation from soil erosion are to be mitigated by avoiding practices that disturb fragile soils. Buffer strips of vegetation are to be left along stream banks to help hold and prevent soil from washing into streams.

7. Commercial, Residential and Industrial

Conflicts between timber management practices and adjacent residential and commercial land uses can best be mitigated by preventing then from occurring. Coordination of land use plans with the planning and zoning of local governments is to be carried out in order to: (1) advise managers of the likelihood of land uses being introduced on adjacent private lands that would conflict with timber management objectives, and (2) advise local governments of the timber management objectives thus allowing them opportunity to plan and zone intermingled private lands.

8. Local Government and Public Services

Accidental disruption of utility services caused by timber management practices can largely be precluded through proper planning. Land use plans are to be used to: (1) inform public service companies of resource areas, including timber, that should be avoided in planning utility route locations, and (2) identify and designate corridors on the public lands where utilities can be placed with minimal land use conflicts. Adverse impacts on local and state highways can be mitigated to some extent through coordination with county and state highway departments.

J. Aesthetics and Human Interest

Here again, the planning processes described in Chapter I are to be used to identify resource values and resolve land use conflicts. In general, however, areas of outstanding scenic quality or human interest are to be exempted from timber production where these values will be adversely impacted by timber management practices.

1. Aesthetics

a. Visual Impacts

Visual impacts are to be reduced by several measures. The appearance of smoke in the atmosphere from area and spot burning of slash is to be minimized by smoke management technology. This involves the coordinated effort of meteorologists and public and private forestry agencies to intergrate burning schedules with weather reports and forecasts so as to produce rapid fuel combustion and quick dispersal of smoke into the upper atmosphere.[54] Alternative slash disposal measures which create no smoke may be feasible; e.g., chipping or burying of slash, or use of equipment utilizing an air curtain combustion system.

Atmospheric dust arising from road construction operations can be somewhat reduced by watering of subgrades during blading and surfacing operations. Dust from log hauling by truck is to be abated by oiling roads or surfacing them with bituminous material or macadam where critical dust conditions exist. Periodic application of water or waste sulfite liquor to dirt or gravel surfaced roads will reduce the dust problem.

The visual impact of cutting practices and logging operations are to be mitigated by utilizing special cutting practices which retain some of the forest overstory. This may involve the concept of continuous canopy management which employs a system of modified shelterwood cutting that defers final removal of the forest overstory until understory regeneration is large enough to present a forest-like appearance.[55]

The adverse phychological effects created by highly visible timber management activities are to be minimized by skillful, perceptive use of landscape management techniques. Landscape management is the art and science of planning and administering the utilization of natural resources in such ways that the resulting effects on the visual resource maintain or enhance man's psychological welfare.[56] Landscape management techniques have various applications. On well traveled roads, a roadside buffer strip of uncut trees and undisturbed ground cover is to be reserved to screen aesthetically unpleasant activity in foreground distance and middle ground distance zones from the view of sightseers. Where clearcut areas will be visible in middle ground distance and background distance zones, negative psychological effects are to be mitigated by: (1) avoiding straight cutting edges and square or rectangular shapes, (2) locating cutting lines along contours so as to conform with topography, (3) blending cutting lines into natural vegetative features, and (4) keeping middle ground clearcuts small. Landscape management techniques are also to be used to reduce the unsightliness of scars on the landscape and unnatural openings created by road construction.[57]

b. Sound, Odor, and Mood

Little can be done about odors emanating from internal combustion engines. The smells of smoke from burning slash and of dust from various operations can be mitigated to some extent by measures described previously under visual impacts. The high noise levels produced by the engines of logging and construction equipment could probably be reduced by improved muffler systems but, so far as is known, there has been no effort in this direction.

Public information and educational practices are to be utilized to help allay unfavorable public reaction to the aesthetic impacts of timber management that exist because of limited knowledge of natural processes. The various news media offer some opportunities in this regard as do outdoor classrooms for children of school age.

2. Geologic Human Interest Values

Identification and designation of unique geological formations in land use plans is the foremost mitigative measure available to preserve their human interest values. Timber management activities are to be planned and executed in such a manner as to prevent damage to such formations. If the values are jeopardized by these activities, the area is to be excluded from timber production.

3. Archeological Human Interest Values

Lands on which archeological sites have been classified for preservation because of national, regional, or local significance shall not be subjected to any timber management practice. In areas containing possible archaelogical values, surveys are to be conducted and new finds are to be investigated and evaluated. When present, no timber management practices that would disturb or otherwise affect them are to be allowed in the vicinity until such a time that their significance has been evaluated and a determination made for their continued protection or salvage and destruction.

4. Historical Human Interest Values

Mitigation is the same as for archeological values.

5. Cultural, Ethnic and Religious

Mitigation of impacts on cultural, ethnic and religious groups are best accomplished through understanding and adherence to civil rights laws and regulations pertaining to employees of the Federal government or its contractors. Cultural groups are to be encouraged to participate in the development of land use plans and avenues of communication are to be cultivated and used. Areas of particular significance, such as sacred

Indian grounds, are not to be subjected to timber management practices when these practices conflict with cultural, ethnic or religious values.

K. Wildfire

The Protection phase of the timber management program in itself incorporates most of the mitigative measures employed to minimize the risk of occurrence and control of wildfires. Consequently, the mitigative measures to be employed in fire control and suppression activities are described in the previous parts of this chapter and will not be repeated here.

Administrative type mitigative measures that relate to the prevention and/or early control of accidental fires are to be employed. These include preattack or prefire planning systems, the shutting down of operations during periods of low humidity, availability of fire fighting equipment on the operations site, clearing around warming fires, proper equipment maintenance, smoking restrictions and others. These types of practices are all designed for the purpose of minimizing the risk of fire occurrence or its immediate suppression and have no impact on the environment.

Although these preventive measures will minimize the occurrence or early spread of wildfires, their complete elimination is impossible. Consequently, the salvaging of burned trees, the restoration of the impacted area through planting or seeding and other practices can be viewed as mitigative measures to be employed, after the fact, to minimize the impact of the fires that do occur.

Bibliography

1. Bishop, D. M., and M. E. Stevens, *Landslides on Logged Areas in South east Alaska*, U.S. Forest Service Research Paper, Nov. 1, 1964.

2. Fredrikson, R. L., *Erosion and Sedimentation Following Road Construction and Timber Harvest on Unstable Soils in Three Small Western Oregon Watersheds*, U.S.D.A. Forest Research Paper PNW-104, 1970.

3. Ries, H. And T. L. Watson, *Elements of Engineering Geology*, John Waley & Sons, Inc., New York, 1921.

4. Tschebotarioff, G. P., *Soil Mechanics, Foundations, and Earth Structures*, McGraw Hill Book Company, Inc., New York, 1955.

5. BLM Manual Supplement 7415 - *Stabilization*, Section .7B2.

6. Environmental Protection Agency, *Guidelines for Erosion and Sediment Control Planning and Implementation*, EPA Publication R2-72-015, August 1972, pg. 218.

7. BLM Manual 9222 - *Chemical Pest Control*.

8. Swanston, D. N., *Mechanics of Debris Avalanching in Shallow Till Soils of Southeast Alaska*, U.S. Forest Service Research Paper PNW-103, Portland, Oregon, 1970, 17 pg.

9. Bishop, D. M., and M. E. Stevens, *Landslides on Logged Areas in Southeast Alaska*, U.S. Forest Service Research Paper NOR-1, Portland, Oregon, 1964, 18 pg.

10. Hall, J. Alfred, *Forest Fuels, Precribed Fire, and Air Quality*, U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, 1972, pg. 36.

11. Franklin, J. F., and C. T. Dryness, *Vegetation of Oregon and Washington* U.S.D.A. Forest Service Research Paper PNW-80, Portland, Oregon, pg. 37-73.

12. Daubenmire, R. and J. Daubenmire, *Forest Vegetation of Eastern Washington and Northern Idaho*, Washington Agricultural Experiment Station, Washington State University, 1968.

13. Thomas, Byron R., James A. Pomerening, and Gerald H. Simson, *Reconnaissance Soil Survey of the Willamette Basin, Oregon*, Special Report 269, Ag. Exp. Sta., Oregon State University, Corvallis, Oregon, March 1969.

14. Pfister, Robert D., *Habitat Types and Regeneration*, paper presented to the Reforestation Coordinating Committee of the Western Forestry and Conservation Association, Seattle, Washington, December 6, 1972.

15. Wessell, W., Tree Improvement Plan for Western Oregon, Oregon State Office, Bureau of Land Management (draft), .23A, December 1972.

16. Bureau of Land Management, 6760 - Stream Preservation and Improvement, Release No. 6-12, Washington, D. C., August 22, 1968.

17. Bureau of Land Management, 5421 - Sale Layout, Release Nos. 5-18 and 5-34, Washington, D. C., February 26, 1970 and Sepember 8, 1970.

18. Bureau of Land MAnagement, 9113 - Roads, Trails and Landing Fields Release No. 9-34, Washington, D. C. August 2, 1966.

19. Bureau of Land MAnagement, 9222 - Chemical Pest Control, Release No. 9-77, Washington, D. C., May 3, 1972.

20. Bureau of Land Management, 5110 - Stream Protection, Release No. 83, Oregon State Office, Portland, Oregon, April 30, 1969.

21. DeVaney, Thomas E., Chemical Vegetation Control Manual for Fish and Wildlife Management Problems, Bureau of Sport Fisheries and Wildlife, Resource Publication #48, U.S. Government Printing Office, Washington, D. C., 1968.

22. Bureau of Land Management, 5421 - Sale Layout, Release No. 543, November 30, 1970.

23. Bureau of Land Management, 9222 - Chemical Pest Control, Release No. 9-22, May 3, 1972.

24. Bureau of Land Management, 6511 - Wildlife Engineering, Release No. 6-36, September 18, 1972.

25. Bureau of Land Management, 6512 - Forest Management, Release No. 6-17, August 20, 1970.

26. DeVaney, Chemical Vegetation - Control Manual for Fish and Wildlife Management Programs - #48, Supt. of Public Documents, 1968.

27. Borovicka, R. L., Consideration of Aquatic Resources with Forest Practices in Western Oregon, Forest Fisheries Habitat Seminar, OSU, Tillamook, Oregon, 1968, 9 pg.

28. Brown, G. W. and J. T. Krygier, Effects of Clear-Cutting on Stream Temperature, Water Resources Res., 1970, 6(4):1133-1139.

29. Brown, G. W., Predicting Temperatures of Small Streams, Water Resources Res., 1969, 5(1):68-75.

30. Brown, G. W. and J. T. Krygier, Clear-Cut Logging and Sediment Production in the Oregon Coast Range, Water Resources Res., 1970, 7(5):1189-1198.

31. Bureau of Land Management, BLM Manual 6512 - Wildlife-Forest Management, January 23, 1969.

32. Bureau of Land Management, BLM Manual 6760 - Stream Preservation and Improvement, July 22, 1968.

33. Burns, J. W., Spawning Bed Sedimentation Studies in Northern California Streams, California Fish and Game, 1970, 56(9):253-270.

34. Burns, J. W., Some Effects of Logging and Associated Road Construction on Northern California Streams, Trans. of American Fisheries Society, 1972, 101(1):1-17.

35. Calhoun, A. and C. Seeley, Logging Damage to California Streams 1962, California Dept. Fish and Game, Inland Fish Admin. Report No. 63-2, 1963, 15 pg.

36. Cordone, A. J., and D. W. Kelley, The Influence of Inorganic Sediment on the Aquatic Life of Streams, California Fish & Game, 1961, 47(2): 189-228.

37. Dyrness, C. T., Soil Surface Conditions Following Skyline Logging, U.S.D.A. Forest Service, Pac. NW Forest & Range Exp. Station Paper PNW-55, 1967, 8 pg.

38. Environmental Protection Agency, Industrial Waste Guide on Loggging Practices, E.P.A., 1970, 40 pg.

39. Froehlich, H.A., Logging Debris - Managing a Problem, In: Proc. Symposium - Forest Land Uses and Stream Environment, October 19-21, 1970, Oregon State University, 1971, pg. 112-117.

40. Hall, J. D., Alsea Watershed Study, Pamphlet, Oregon State University, Corvallis, Oregon, March 1967, 11 pg.

41. Haupt, H. F., and W. J. Kidd, Jr., Good Logging Practices Reduce Sedimentation in Central Idaho, Jr. Forestry, 1965, 63(9):664-670.

42. International Pacific Salmon Fisheries Commission, Effects of Log Driving on the Salmon and Trout Populations in the Stellako River, Int. Pac. Sal. Fish. Comm., Prog. Rep. 14, 1966, 88 pg.

43. James, G. A., The Physical Effect of Logging on Salmon Streams of Southeast Alaska, U.S.D.A. Forest Service, Alaska For. Res. Station, Paper No. 5, 1956, 48 pg.

44. Lantz, R. L., Guidelines for Stream Protection in Logging Operations, Oregon Game Commission, August 1971, 29 pg.

45. McMynn, R., Strips of Trees Could Protect Fish from Loggers, Western Fish., 1970, 80(6):20-24.

46. National Marine Fisheries, Report on Effect of Chemical Fire Retardants on the Survival of Juvenile Salmonids, Report to Bureau of Land Management, Portland Service Center, 1972, 23 pg.

47. Norris, S. A. and D. G. Moore, The Entry and Fate of Forest Chemicals in Streams, In: Proc. Symposium - Forest Land Uses and Stream Environment, October 19-21, 1970, Oregon State University, 1971, pg. 138-158.

48. Oregon Game Commission, Precautions for Stream and Fish Protection in Road Construction and Logging Operations, Proceedings Symposium - Forest Watershed Mgt., Oregon State University, 1963, pg. 338-340.

49. Platts, W. S., The Effects of Logging and Road Construction on the Aquatic Habitat of the South Fork Salmon River, Idaho, U.S.D.A. Forest Service, Zone Fishery Biologist, 1970, 4 pg.

50. Sheridan, W. L., and S. T. Olson, Timber Harvest and the Salmon and Trout Fisheries of Southeast Alaska, Western Div. Amer. Fish Society, July 1970, Victoria, B.C.

51. U.S. Department of Agriculture, Guides for Protecting Water Quality, Pacific NW Region, Forest Service, 1972, Pamphlet, 27 pg.

52. Wustenberg, D. W., A Preliminary Survey of Controlled Logging on a Trout Stream in the H. J. Andrews Experimental Forest, Oregon, M.S. Thesis, OSU, 1954, 51 pg.

53. BLM, Investigation of Continuous Canopy Forest Management Systems, (Unpublished manuscripts, Portland Service Center, Portland, Oregon August 1971).

54. Hall, J.A. Forest Fuels, Prescribed Fire & Air Quality, U.S.F.S., PNWFRES, Portland, Oregon 9772. pg. 36.

55. BLM (as above) pg. 53.

56. U.S.F.S., Northern Region, Forest Landscape Management, Vol. 1, Missoula, Mont. Feb. 1972, pg. 5.

57. Ibid., pg. 49-126.

V. ADVERSE IMPACTS THAT CANNOT BE AVOIDED

This section discusses the adverse impacts which can be expected to remain after the applicable mitigation measures described in the preceding chapter have been applied. It comprises a compilation of unavoidable impacts not subject to mitigation and the net residual adverse effects likely to remain despite mitigation efforts. These unavoidable impacts do not take into consideration those instances where potential land use or resource programs conflict and are unreconcilable, resulting in a management decision to classify a particular area for a single use or selected uses. Depending upon the nature of the classification or action, the unavoidable impacts of timber management practices set forth in this chapter may be either diminished or increased.

A judgement factor was imposed to estimate the effectiveness of mitigation measures based on assumed thoroughness in execution and probability of favorable technical results. It has been assumed that prescribed mitigation procedures will be used and enforced, adequate money and manpower will be available, and the contractor or private operator will be cooperative. However, it is recognized that inadequate planning or administration, accidents, unpredictable natural phenomena and uncontrollable human behavior will result in some instances of adverse impacts not identified in this chapter.

In some of the sections that follow, the development, protection, cutting practices, logging methods and transportation phases have been combined since their continued separation in this and subsequent chapters is not as meaningful or as helpful to the reader as in previous chapters.

A. Ecological Interrelationships

Most practices will alter the appearance of the ecosystems and temporarily disrupt the balanced relationships between its components, particularly those practices that involve vegetal destruction or removal and soil movement. In these instances the nutrient cycle, hydrologic cycle, and energy flow will be interrupted until the impacted area is revegetated and the ground stabilized. If fragile areas are disturbed the period necessary to reestablish the ecological relationships that existed prior to the action can be lengthy. In the case of the areas occupied by roads, these relationships will never be restored during the life of the road. It can be safely assumed that almost any action of man that effects the biotic community and/or the physical environment will impact the ecosystem to some degree regardless of the mitigative measures that are brought to bear. However, with the proper application of timber management practices, the impact would be minimal in terms of the basic processes of the ecosystem and of relatively short duration.

Perhaps the most significant unavoidable impact in terms of ecosystems will be the gradual demise of the old growth forest along with its attendant biotic community as a result of timber harvesting on the lands classified for timber production. While some members of the community may be capable of relocation of old growth stands not subject to cutting or be adaptable to young growth forests, the extensiveness of this ecosystem will be significantly diminished. In the process, new disclimax species and man-caused seral stages will reduce the population of some native vegetative species.

B. Physiography, Geology and Minerals

An undeterminable amount of mass wasting will occur on localized areas; the magnitude being contingent upon the rock type, rock structure, weather, hydrology and soil types. Those development practices that leave a higher percentage of the surface exposed on steep slopes, underlain by unconsolidated rock will constitute the major part of this condition. Cutting practices and logging methods carried out on moist steep slopes which involve cutting a high percentage of the trees and the construction of tractor skid trails can be expected to result in some mass movement of soil and geologic material. Road construction will result in some indeterminable amount of mass wasting.

C. Soils

Whenever the natural interactions of parent material, vegetation and topography are disrupted by an action, the soils will be affected. Mitigative measures can reduce erosion but some degree of impact will remain until natural interactions have time to reach harmony with each other. The degree of impact is likely to be longer on soils of higher erosion and slide hazard as well as those of lower site quality.

Development practices, such as scarification, mechanical-trenching and furrowing, area burning, spot burning, and hand clearing, and cleaning will result in some localized erosion due to the disturbance of soil, surface litter and vegetation. Except for a few isolated instances, erosion will be minimum.

Fire line construction and backfiring can be expected to result in an undeterminable amount of erosion. Because of the fraility of the Taiga Forest this amount may reach significant proportions. Some erosion and/or soil compaction will occur regardless of the cutting practice or logging methods used, particularly on steep terrain.

Landslides and gravitation erosion will periodically occur along roads as a result of freeze-thaw actions and from the water saturation of slopes during the rainy and winter seasons. Severe rain storms will cause blockages of drainage facilities resulting in soil movement and loss. Some streambed disturbance will result during bridge construction and culvert installation. Accidental spills of chemicals, oil, etc., will occur but their impact can be expected to be minimal.

D. Water

Heavy rains immediately after a prescribed burn, before any or all rehabilitation measures can be accomplished or can take effect, may cause suspended sediment to be carried into streams even through a wide vegetative filter strip. Heavy rains may also cause an increase in slope instability with a large debris avalanche or soil slump resulting. In such events, vegetative filter strips and buffer strips of timber and shrubs may be completely ineffective in preventing masses of debris and soil from reaching and damaging a stream. Unforeseen shifts in wind during chemical weed and brush control can cause drift of chemical pesticides into streams and bodies of water.

Unavoidable impacts of applying insecticides, retardants, etc., and backfiring are the same as chemical weed and brush control and burning respectively, as described in the previous paragraph. The construction of a fire line on a going fire, requiring quick control may not allow time for thorough planning and best location of fire lines. The same urgency may dictate that fire trails be built by heavy equipment, with resulting degradation of water quality. During severe fire weather, several fires burning concurrently or at short time intervals may preclude the use of limited manpower in applying erosion control measures promptly to fire lines.

The removal of vegetation from clearcutting in northwestern Oregon will cause changes in the seasonal distribution of runoff and in the magnitude of some late fall peak flows. Streamflow will be increased during the heavy rainfall periods, November through April. On sites with unstable soils, this increased streamflow or occasional higher peakflow could conceivably initiate a cycle of stream erosion and slope failures with a significant decrease in water quality.

Felled trees may unavoidably slide down steep slopes and into or through streamside buffer strips, causing localized soil erosion or disturbance of the vegetation along the streambank. Some soil compaction is inevitable on any area that is tractor logged. Temporary, localized soil distrubance and erosion can be expected in most logged areas regardless of the method employed.

Streams near or adjacent to road construction projects can be expected to carry additional suspended sediment during the life of the facility. This sediment may be derived from excavation, embankment and bridge construction, culvert installation, and surface runoff from culverts and road and fill surfaces. Subsequently, culverts, slopes and surfaces may fail from water saturation, heavy loading or from blockage by debris following heavy rains or melt off, causing erosion or drainage to bypass regular channels and carry sediment in surface runoff.

E. Air and Microclimate

There will be occasions when smoke from prescribed burning will find its way into the lower atmosphere over population centers. These occurrences will be significant only as a temporary nuisance. Inevitably, as long as prescribed fire is used, there will be misapplications due to human error and accidents of nature. Some brush fields will be created and some forest sites made temporarily unproductive by micro-climatic changes.

Inadequate research makes it impossible to predict what unavoidable adverse impacts any prescribed burning and brush removal might have on the micro-climates of the Taiga Sub-biome. However, this ecosystem is generally considered a fragile one. Burning practices and brush removal might cause very significant changes in local climates, particularly in permafrost areas. The discussion of prescribed burning also applies to the unavoidable impacts of backfiring on local climates.

When it is necessary to clearcut insect-infested timber on a severe site and to burn the slash to forestall an epidemic, the resulting exposure may create micro-climatic conditions which make regeneration of the site very difficult. In addition, deviation of the general climate from its normal pattern for a year or two following normal cutting practices may cause micro-climatic changes which inhibit regeneration and favor the invasion of the site by brush. Cutting practices could have significant unavoidable impacts on the micro-climates of the Taiga Sub-biome, but lack of research makes these impossible to identify.

The unavoidable adverse impacts of road construction and log hauling on local climate are relatively minor. Air quality will be temporarily degraded by engine emissions and dust will sometimes be a nuisance in the vicinity of road construction operations and along logging roads. Micro-climates will be permanently modified in limited areas on road rights-of-way.

F. Vegetation

1. Terrestrial Vegetation

Significant short term adverse impacts (e.g. immediate and extensive destruction of existing vegetation) will frequently be accepted as a cost of avoiding adverse long term impacts (e.g. excessive delay in regenerating and developing a new forest similar to the one removed.) The classic example will occur most frequently in the Northwest Coastal Subbiome where clearcutting, scarification, aerial spraying of herbicides and area burning may be used to insure timely replacement of a well stocked Douglas-fir forest as opposed to vegetative cover of shrubs, hardwood trees and scattered hemlock or Sitka spruce. Recommended mitigating measures therefore are often in conflict between long term and short term impacts; when this occurs attention is usually given to long term impacts.

Adverse impacts may occur due to accidental misapplication of certain practices in the face of unseen environmental conditions. An example could be the failure of tree regeneration amid flourishing herbaceous or non-coniferous woody vegetation following application of normally "safe" actions such as (1) shelterwood cutting in the Montane and Taiga

Sub-biomes, and (2) clearcutting on relatively cool-moist sites in the Northwest Coastal Sub-biome and certain vegetative zones of the Montane Sub-biome.

2. Aquatic Vegetation

The natural rate of sedimentation of aquatic ecosystems will be increased slightly by many timber management practices. Increased sedimentation shortens the natural life of lakes, ponds, marshes and estuaries by filling their basins, thereby speeding up plant succession and eventual conversion to land masses. Aquatic plants are ultimately replaced by terrestrial vegetation in this process which usually requires centuries under normal conditions.

G. Animals

1. Terrestrial Wildlife

The implementation of many mitigation measures will serve only to reduce, and cannot avoid, short term adverse impacts on terrestrial wildlife. Individual small animals, for example, will be killed or displaced by timber management activities such as scarification, mechanical brush cutting, area burning, falling and bucking, yarding and road construction. The population of species that are associated with old growth forests, such as the northern spotted owl, pine marten, and pileated woodpecker, can be expected to be reduced as the extent of their habitat is diminished. Mainline roads will cause a long term unavoidable impact due to the presence of people and the associated disruption and destruction of wildlife.

2. Aquatic Wildlife

Short term disruptions of the aquatic habitats and subsequent damage to aquatic wildlife will occur as a result of accidental stream blockages, soil erosion, etc. Mainline roads will cause a long term unavoidable impact due to the presence of people and the associated disruption and destruction of wildlife.

2. Domestic Livestock

Impacts of timber management actions on sheep, cattle and horses are relatively short term and minor.

H. Micro and Macro-Organisms

1. Soil Organisms

Some short term adverse impacts will occur in the form of reductions and imbalances in organism populations. This will result from those practices which compact the soil, reduce soil moisture, raise soil temperatures or decrease carbon supplies. Usually, the impact will be short lived because of the dynamic reproductive characteristics of these organisms. In the case of continuing erosion and permanent roads, the adverse effects will continue until the sites are stabilized or the roads reclaimed. The impact of localized mass soil movements that result in the exposure of bare rock or parent material will be long term.

2. Aquatic Organisms

The cumulative effect of all forest management activities will be to increase the rate of sedimentation in aquatic ecosystems. Unpredictable mass soil movements which occur along roads and in logged areas will further add to natural stream sedimentation. The effects of excessive sedimentation on all organisms is unknown, but many populations are adversely affected.

I. Human Settlement and Land Use

1. Human Settlement

Health and Safety. The primary unavoidable impact will involve workers in timber related jobs; accidents that cause injury and occasionally deaths will happen. Accidents involving the motoring public and log trucks and other logging equipment will occur as long as simultaneous use is made of the roads.

There will be occasions when smoke from slash fires will drift over inhabited areas despite mitigative measures, however, no significant impacts are expected.

2. Mineral Development

There are no unavoidable adverse impacts of significance.

3. Wilderness

Timber management will pose no threat of damage to the wilderness values of the Northwest Coastal and Montane Sub-biomes; providing unique aesthetic and natural attributes are recognized and protected where they exist. However, any implementation of timber management practices could have severe unavoidable impacts on the de facto wilderness areas of the Taiga Sub-biome.

4. Recreation

Timber management will have some unavoidable adverse impacts on various facets of recreation. Natural waters which provide fishing, boating and swimming opportunities may be muddied occasionally or invaded by debris carried downslope from logged areas in surface water runoff. Some cutting practices and prescribed burning may eliminate recreation from an area for a time. The smoke, traffic noise and dust associated with certain practices will cause local discomfort to the public in the course of their enjoying the outdoors.

5. Grazing

No adverse impacts will occur except in those instances where grazing is subjugated to timber management goals. Even with possible grazing reductions the impact on a national basis would be insignificant, however, on a local basis, some livestock operators could be adversely effected.

6. Agriculture

Barring unavoidable accidents and natural phenomena, there should be no unavoidable impacts to agriculture.

7. Commercial, Residental and Industrial

There should be no unavoidable impacts on residential, industrial, or commercial enterprises.

8. Local Government and Public Service

There will be no unavoidable impacts on public services, with the exception of possible accidental interruptions of utilities located in a timber management area.

There will be unavoidable impacts on some local and State functions, such as increased highway maintenance, due to the traffic and activities associated with timber management.

J. Aesthetics and Human Interest

1. Aesthetics

Timber management will continue to cause impairment of aesthetic values, even when all feasible mitigating measures are carefully applied. Atmospheric smoke from prescribed burning will be visible at times, as will dust from logging and road construction operations, and from truck hauling of logs. Clearcutting and heavy partial cuttings will detract from the natural appearance of the forest. So will unsightly road cuts and fills, and the occasional massive soil movements which will occur as results of some accidental or ill-advised construction and logging operations. The smells and sounds of timber management operations will also continue to affect the moods of forest visitors.

2. Geologic Human Interest Values

There will be no unavoidable adverse impacts on geologic features of human interest.

3. Archeologic Human Interest Values

Due to the nature of archeological sites (difficult to locate) there may be an occasional site destroyed inadvertently during the execution of an action.

4. Historical Human Interest Values

There will be no unavoidable impact on historical values.

5. Cultural, Ethnic and Religious Values

There will be unavoidable impacts on cultural, ethnic and religious values. When different cultural styles meet for any length of time, there is inevitably a merging of the different styles and values. When two cultures are strongly opposed as between recent counter-cultures and older established cultures, attempts to mitigate completely the adverse effects is seldom successful.

K. Wildfire

It is impossible to eliminate all wildfires in the course of carrying out the timber management program due to accidents, natural causes, and the carelessness of man. As a result, all the unmitigated impacts on the environment associated with wildfires, as described in Chapter III, will continue to occur on the effected areas along with the unavoidable impacts of the protection measures taken to control them.

VI. SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY

Timber management is not a short-term use but a continuous use which involves different practices being applied to different parts of the forest over time, the magnitude and frequency of which is dependent upon the intensity of the program. Most of the individual practices carried out on a particular area do imply a short-term use. However, the time frame used in this statement is identifying the long-term impact is relatively long, stretching out to 100 years, in order to equate timber management with the approximate rotational period of tree harvest. This is because trees represent the predominant life form of the forest and the primary support to the productivity of the biotic community and, in turn, the amenities it provides society.

A. Ecological Interrelationships

The productivity of an impacted area will be significantly reduced in those instances where permanent structures, primarily roads, are constructed, bare rock is exposed or unstable soil conditions exist. However, if the productivity of an ecosystem is defined in terms of the biomass it produces, the overall impact of timber management will be to increase the productivity of the forest due to the replacement of slow growing overmature stands with fast growing young stands. The practices associated with the growing and harvesting of a renewable resource increase the yield of wood material along with some other environment components such as certain wildlife species, over what nature alone can produce. The continual removal of the nutrient containing resource over successive rotations and the practices to which the land is subjected may have a dampening effect on productivity over time. If so, it can be expected to be offset by artificially introduced nutrients through fertilization. Long term ecological interrelationships will be affected as a result of establishing new disclimax species and seral stages.

Highly productive ecosystems such as the Northwest Coastal Forest are generally in good equilibrium while the natural balance is fragile in communities of low productivity such as the Taiga and parts of the Montane Forests. Short-term practices pose their greatest threat to the continuing productivity of the latter forests where plant species have low growth rates and animals have low reproduction rates. If significantly disturbed such ecosystems recover slowly.

B. Physiography, Geology and Minerals

The construction of roads will expose areas to potential erosion and mass movement which will decrease future productivity on the effected areas by removing or destroying the soil layer upon which new growth is dependent. However, road construction will also expose the underlying rock formations which in turn will give a better understanding of the geology of the area. Thus, long-term productivity can be enhanced to the extent that construction may expose potential economic mineral deposits.

C. Soils

Productivity is reduced when the soil is severely disturbed, eroded or compacted. Productivity loss due to erosion has the greatest longevity, soil disturbance the shortest and compaction is intermediate. While some of the forest development practices such as scarification and burning may have a short-term detrimental impact on localized areas, most practices such as planting and weed control will either increase or not affect long-term productivity. The removal of material (trees) in the course of logging could lead to slight reductions in soil nutrition over time. The area occupied by permanent roads will not be productive during the life of the facility. Their possible reclamation along with temporary roads, can be expected to result in reduced productivity where extensive cuts and fills are made. In all probability the full productivity of reclaimed roads and quarry sites will not be restored despite the mitigative measures taken. The potential for decreased long-term productivity as result of any management practice that significantly affects vegetal and ground cover, such as fire lines, is greatest in parts of the Taiga Forest and the alpine zones of the Montane Forest.

D. Water

Where slopes and stream channels are stable, increased runoff resulting from cutting practices has no adverse effects and suspended sediment concentrations will remain relatively stable. Periodic erosion along roadways resulting from seasonal rains and storms will reduce the productivity of the aquatic ecosystem for a short period of time. Whereas, localized situations will occur where water quality will be impaired temporarily, timber management practices will increase water yields and have a minimal impact on its quality on a long-term basis.

E. Air and Microclimate

The potential long-term impact of practices which destroy vegetation and/or cause significant soil disturbance on the micro-climate of the Taiga Forest are unpredictable because research is lacking. In general, however, the practices associated with timber management will not affect the micro-climate or air as they relate to the long-term productivity of the forest.

F. Vegetation

1. Terrestrial Vegetation

The short-term use of the land for timber production will increase long-term vegetative productivity. Vegetation is a renewable resource, capable of re-establishing on most areas that are denuded during timber harvest and forest development actions. Through natural vegetation and man-controlled forest development actions the former productivity of the site can be both restored and increased over time. Timber productivity, especially, will be increased through timber management practices, i.e., development, protection, commercial thinning, mortality salvage and the timely harvest of the crop prior to the period of natural declining growth and general stand deterioration due to age and disease. However, where adequate consideration is not given to preserving the necessary environmental conditions necessary for regeneration and actions occur that damage or destroy the soil to the extent that technological or economic limitations preclude rehabilitation the long-term productivity will be reduced.

2. Aquatic Vegetation

Timber management practices generally have a very minor detrimental effect on the long-term productivity of aquatic plants. In some instances the productivity of plants in standing water habitat may be initially increased for a period of years because of favorable habitat changes. Conversely, massive earth slides in stream channels will cause moderate to severe long-term losses in productivity of riparian vegetation in the impact area. The long-term effect of increased sedimentation from other actions is to shorten the natural life span of some aquatic ecosystems.

G. Animals

1. Terrestrial Wildlife

Short-term use of the land for timber production will in general increase the long-term productivity of the forest in terms of terrestrial wildlife. Removal of dense old-growth forests and restoration of new forests with more open conditions with resulting increased food supplies will actually enhance long-term producitvity of such species as deer and elk and provide for a greater diversity of wildlife species. An exception to the rule involves species dependent upon an undisturbed environment, where normally short-term impacts such as the disturbance or destruction of habitat could reduce future populations in areas available for timber production.

2. Aquatic Wildlife

Short-term use of land for timber production will not significantly endanger long-term productivity of aquatic wildlife. While eutrophication will be accelerated, primarily as a result of road construction, its contribution to this natural process will be minimal. Any serious accidents can damage portions of the aquatic habitat, however, widespread or permanent damage of entire river systems as a direct or indirect result of timber management is extremely unlikely.

3. Domestic Livestock

Short-term use of the land for timber production will have little adverse impact on long-term productivity for domestic livestock. Long-term productivity is likely to be increased in those areas where timber and livestock management are judged to be compatible. However, due to the limited use of forested areas by livestock, this increase will be minimal.

H. Micro and Macro-Organisms

1. Soil Organisms

Except in localized areas where massive soil movement and continuing erosion take place, along with permanent road sites, will the long-term productivity be effected.

2. Aquatic Organisms

Measures to mitigate adverse impacts will help maintain the long-term productivity of aquatic life because water quality will generally benefit from these measures. However, unpredicted events and accidents caused by timber management practices can have a serious effect on aquatic life in small streams for a few years. The effect on long-term productivity of micro and macro-organisms is not known.

I. Human Settlement and Land Use

1. Health and Safety

Due to industrial accidents and accidents involving public and private vehicles, there will be a few losses of life and serious injury each year. Relating this to society as a whole, they represent an adverse impact on long-term productivity.

2. Mineral Development.

Timber management actions will have no long-term effect on mineral productivity.

3. Wilderness

Any timber management practices initiated on wilderness-type areas will destroy their undeveloped or pristine nature. The time necessary for the signs of commercial human activity to disappear will be many generations into the future, thereby constraining future land use flexibility and potential wilderness productivity.

4. Recreation

The effect of any given timber management practice will not seriously impair future recreational values. However, if these practices are viewed in the context of a continuum, recreation values will be impaired to the extent that the types of environment that some recreationists enjoy is being disturbed, e.g. solitude, tranquility, etc.

5. Grazing

While livestock will be temporarily dislocated on a short-term basis, potential long-term productivity will generally be increased due to additional forage.

6. Agriculture

There will be no long term adverse effects on agricultural productivity as a result of practices associated with timber management. In some instances, productivity will be enhanced due to increased water yields flowing into irrigation systems.

7. Commercial, Residential and Industrial

No impacts on long-term productivity or potential for the development of these types of facilities are envisioned.

8. Local Government and Public Services

As long as timber management activities continue, some long-term effects will be felt by State and local highway departments by way of diverting monies to increased road maintenance and related costs.

J. Aesthetics and Human Interest

1. Aesthetics

On a short-term basis, the harvest of old growth stands on areas available for timber production will adversely impact those people who enjoy viewing large and aged trees. However, on a long-term basis, the replacement of dead and dying overmature trees will increase many of the aesthetic values associated with forests. The visual evidence of some timber management practices, such as clearcutting, will extend into the distant future and thereby impact the long-term aesthetic productivity of the forest in the eyes of certain of its viewers.

2. Geologic Human Interest Values

Any impact that accidentally obliterates or substantially alters unique geologic features will decrease their long-term human interest values.

3. Archeologic Human Interest Values

Archeological sites and the scientific values contained therein are lost forever once destroyed.

4. Historic Human Interest Values

Inadvertent destruction or damage to historic sites would have long term impacts if the sites were not restored. Even with restoration, there would be some diminuation in historic value.

5. Cultural, Ethnic and Religious Values

To the extent that members of a particular culture are affected and changed by contact with members of a different culture, there will be some long-term impacts on those individuals. The impact may be particularly significant on the Alaska natives residing in the relatively undeveloped forests of the Taiga Sub-biome.

K. Wildfire

The occurrence of wildfires will often result in the immediate devastation of the biotic community and contamination of the atmosphere by smoke, the magnitude of which will be dependent upon the conditions that characterize the affected area and its size. The short-term use can be described as wasteful consumption, however, long-term productivity is often benefited by improved wildlife habitat and the replacement of overmature decadent stands with vigorous young growth forests. Depending upon the severity of the burn, success in rehabilitation measures and other factors, the rate of recovery will vary with the fraility of the impacted area. In most instances, its original productive capacity will be restored although full restoration may require decades. However, in some instances, where soil mantles have been completely destroyed, its original productivity will not be restorable within the forseeable future.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section is focused on identifying the impacts of timber management from the perspective of irrevocable commitments or losses of resources due to such causes as resource destruction or extraction, massive erosion, destruction of human interest values, elimination of endangered species and their habitat, and irreversible changes in land use. The consideration of any of these consequences is based only upon the existence of risks residual after the fullest possible mitigation efforts, previously discussed, have been employed.

A. Ecological Interrelationships

While certain components of the biotic community and physical environment, such as endangered species, would represent irretrievable losses if annihilated as a result of some catastrophic event, the impact on basic ecological processes would be temporary and in all probability recover and continue on. As stated previously, the ecology of localized areas may be permanently impacted because of land slides, etc; however, their rate of incidence and amount of land effected would be minimal. The greatest risk of irretrievable losses of the ecosystem following the loss of vegetal cover and erosion exists in the fragile areas of the Taiga Forest and the alpine zones of the Montane Forest. It should be pointed out, however, that much remains unknown regarding the ecological interrelationships that exist throughout the Coniferous Forest Biome, so absolute certainty cannot be ascribed to the general apparent lack of irreversible or irretrievable impacts.

B. Physiography, Geology and Minerals

Erosive processes induced by removal of the vegetative cover and the construction of roads will produce an indeterminable amount of localized mass wasting or mass movements which cannot be reversed or retrieved, no matter what mitigating measures are taken. Any resulting soil deposition into bodies of water will represent a permanent loss of the soil resource. This is also a natural process which tends toward an equilibrium over geologic time but in terms of man's life time, it results in a disequilibrium because of the time required for the area to stabilize.

C. Soils

The irreversible impact and commitment of the soil resource is closely correlated to the physiographic and geologic factors described in the above paragraph. There are additional impacts, however, if the assumption is made that permanent roads will remain in perpetuity. In this case approximately 2 to 5 percent of the soil surface will be committed to a relatively irreversible use, although the trend towards logging systems which require less roads would reduce these percentages in the future. Furthermore, the soil, rock, gravel and other materials used to construct the roads and structures could also be viewed as representing a form of depletion and a permanent commitment of resources. In a theoretical sense, however, roads could be "dismantled," and the areas returned to a productive state if society's values so deemed necessary. Additionally, some soil loss can be expected as a result of water and wind erosion.

D. Water

Watershed values of a drainage are irretrievably commited, to a degree, in those instances where bare rock has been exposed or enlarged as a result of a catastrophic massive soil movements. Landslides can also cause the destruction of a natural stream channel, resulting in its rechannelization, and the accompanying permanent loss of soil and other materials.

E. Air and Micro-Climate

Under extreme conditions, natural restoration of the original micro-climate may take a long time, but there will be no irretrievable commitment to any fixed micro-climate.

F. Vegetation

1. Terrestrial Vegetation

Except for the actual material destroyed, consumed or removed at the time an activity is carried out there are relatively no known irreversible or irretrievable impacts of timber management on vegetation since it is a renewable resource. Even where drastic misapplications may occur and result in extensive delays in tree regeneration, natural plant succession and/or technical progress can be expected to restore the site to a forest condition. Only where landslides expose rock surfaces can the forest condition be considered irretrievable.

2. Aquatic Vegetation

The natural process of the conversion of standing water habitats to land masses will be accelerated by those timber management practices that contribute to sedimentation. Massive earth slides are the most drastic events in localized areas, but the cumulative effects of increased sediment from other actions will cause the greatest impact on aquatic plants.

G. Animals

1. Terrestrial Wildlife

In the course of carrying out timber management activities some irretrievable losses will occur as a result of animal mortality, however, these are not irretrievable in the sense that wildlife are a self-perpetuating renewable resource.

Any loss of an endangered or threatened species will constitute a potential irreversible and irretrievable commitment. Small, non-mobile species with limited habitats and only local distributions, e.g., the Larch Mountain Salamander, are especially vulnerable, other mobile species with widespread distribution, e.g., the spotted owl, could possibly be eliminated from a specific area for a long period of time.

2. Aquatic Wildlife

The most vulnerable aquatic animals are the endangered or threatened species fishes, the populations of which could be severely damaged and possibly exterminated from an entire river system as a result of a major timber management related accident. Examples include Lahontan cutthroat trout, the Colorado River squawfish and the Gila Trout of New Mexico. Massive earth slides caused by any activities on steep terrain are the best illustration of the adverse effects of heavy sedimentation on a localized area. Aquatic habitat lost in the process is seldom restored by natural means.

3. Domestic Livestock

There are no known irreversible or irretrievable impacts of timber management on domestic livestock except for the rare instances of animal mortality due to logging truck mishaps.

H. Micro and Macro-Organisms

1. Soil Organisms

Based on the extent of current knowledge, irretrievable commitments will be limited to localized areas where the soil matter has been removed as a result of massive soil movements or continuing erosion.

2. Aquatic Organisms

The alteration of habitat conditions could favor the existence of one species at the expense of another, however, no irreversible or irretrievable commitments are known with present knowledge.

I. Human Settlement and Land Use

1. Health and Safety

Accidents among timber related employees that cause permanent injury or death are irreversible and irretrievable. This also applies to members of the public injured or killed in accidents involving log trucks or other equipment. The attendant monies expended in the form of compensation or welfare assistance represent irretrievable commitments of capital resources.

2. Mineral Development

Common varieties of minerals may be excluded from development in favor of timber production goals but this would not represent an irreversible action or loss.

3. Wilderness

Any existing de facto wilderness areas committed to timber management would result in an irrevocable loss of wilderness within the foreseeable future.

4. Recreation

Timber management does not commit recreational values to irrevocable loss or degradation. However at the time a given practice is carried out some recreational values, e.g. solitude, may be impacted thus representing an irretrievable loss to the individual affected.

5. Grazing

Some extensive areas of forest range may be commited to timber production, however, this classification does not constitute an irreversible action. However, any amount of livestock production forgone, where grazing capacity is affected by timber management objectives, represents an irretrievable loss.

6. Agriculture

While somewhat farfetched, any loss of soil caused by timber management activities can be considered irretrievable in terms of potential agricultural development of an area.

7. Residential, Commercial and Industrial

There will be no irreversible and irretrievable loss of lands for these uses.

8. Local Government and Public Services

There are no known irreversible and irretrievable commitments of resources with the exception of manpower or capital expended in the course of maintaining or protecting facilities such as State and county roads used in the course of timber management activities.

J. Aesthetics and Human Interest

1. Aesthetics

Timber management activities will make no irrevocable commitment of aesthetic values. Even old growth forests could be re-established if harvesting activities were to be terminated, although it would take several centuries in time. However as long as timber management practices are carried out irretrievable losses will occur at the time, in the form of some disturbed aesthetic value.

2. Geological Human Interest Values

Accidental damage or destruction of geologic sites would, within the time-frame of man's interest, be irreversible and irretrievable.

3. Archeologic Human Interest Values

Inadvertent damage or destruction of archeological sites will be irreversible and irretrievable. If the sites were not completely destroyed, however, enough salvage might be possible to retain their value.

4. Historical Human Interest Values

Conceivably all historic sites that are the works of man could be restored should they be destroyed. However, their values would be diminished and, in effect, the values lost irretrievably.

5. Cultural, Ethnic and Religious Values

In a theoretical sense, there would be no irreversible and irretrievable loss of cultural, ethnic or religious values caused by timber management activities on the assumption that people could revert to their original cultures. For all intents and purposes, however, the nature of man is contrary to this assumption and therefore where timber management does impact these life styles, beliefs or values, they must be considered as irretrievable.

K. Wildfire

Since fires often run wild prior to being brought under control they could conceivably destroy the habitat of endangered species, the species themselves, or man-made structures of historical or archaeological significance. Normally any permanent impact would be localized to those isolated instances where massive landslides have resulted in the exposure of bare rock formations. The vegetation consumed, the animals killed, etc. represent irretrievable losses of resources impacted at the time of the fire.

VIII. Alternatives

A. No Timber Management Program

This alternative would require the cessation of all timber management practices wherever they are currently being carried out.* While a no-timber management program is an alternative to the current program carried out on Bureau administered forests in the contiguous Western States it is not an alternative to the current program for interior Alaska. For in this region over 99 percent of the forest is undeveloped and untouched by any timber management activities and promises to remain so for at least the next ten years. Consequently, this alternative is for all intents and purposes the program for interior Alaska and many of its environmental impacts typify the current situation.

It is important to point out that, with the exception of interior Alaska, the Bureau administered lands are intermingled with private or other publicly managed forests, often as small isolated blocks or in a checkerboard pattern of squares 640 acres in size or smaller.

Consequently, even without a Bureau timber management program, the timber management practices carried out by adjacent private landowners or managers will continue to have an impact on the environment of the Bureau administered forests insofar as road building and log hauling across the public lands and other activities are concerned. However, these impacts are beyond the scope of this statement.

---

*It is assumed that some of the protection practices associated with timber management in this statement, such as fire suppression and control along with the reforestation of denuded areas, will in all probability continue to be carried out to some extent to protect and enhance non-timber values and uses. It is also assumed that some roads will continue to be built in order to make these values and uses available to the public, Consequently, their environmental impacts would continue, however, they are not repeated under this alternative.

The immediate environmental impact of this alternative will vary somewhat within the three general regions i.e., western Oregon, interior Alaska, and the remaining Western States. For example, the no-timber program will not affect the "natural" undisturbed environment of the interior Alaska forests. On the other hand, the highly developed and intensively managed forests of western Oregon would require many decades to return to a semblance of a relatively undisturbed state. While recognizing that these kinds of differences do exist the environmental impacts will mostly stress the long-term effects of this alternative regardless of the locale.

1. Aesthetics and Human Interest. The most significant impact of a no-timber program on aesthetics will be in western Oregon with the cessation of clearcutting on 19,000 acres annually. (Approximately 800 acres are clearcut each year on the remaining forests.) Areas recently harvested

could be reforested within 1 to 2 years and the succeeding growth of the trees in the next 10 to 15 years would erase most of the undesirable characteristics associated with clearcut areas. The natural succession of plant and tree species will take place over time and the preponderance of over mature or old growth stands will be generally pleasing to most forest viewers. Reduced road construction along with the elimination of the smell, sound, dust and smoke of other operations will contribute further to the "natural" appearance or mood conveyed to forest visitors.

The increased presence of lightning prone flammable dead trees or snags resulting from natural mortality and insect and disease infestations in conjunction with the reduced access resulting from less road construction will increase the risk of naturally caused fires and man's ability to control them; respectively. This will be offset in part by the elimination of fires stemming from timber management practices. Nonetheless, the increased incidence of wildfires will significantly impact aesthetic as well as other values. The increase in unharvested dead trees due to natural mortality and insect and disease infestations will also affect aesthetic values.

2. Air. The cessation of the prescribed burning of approximately 9,000 acres of logging debris each year in western Oregon will eliminate the temporary nuisance of the resulting smoke on local inhabitants. In general, however, there will be little or no change in air quality under the no-program alternative.

3. Ecological Interrelationships. The basic ecological processes involving the nutrient and hydrologic cycles and the energy flow will be relatively undisturbed. However, natural forces and human activities will continue to influence various components of the ecosystem. The characteristics of its basic living component, vegetation, will change over time following a cyclic successional pattern. Along with it the populations and species make-up of forest life will change as the vegetation changes in terms of species and their stages of maturity. (The specific changes are described under the appropriate environmental components).

4. Recreation. The relatively high quality of undisturbed streams and lakes will appeal to boaters, fisherman and swimmers so long as accessibility and fish habitat are unimpeded. Conversely, there will be fewer recreational opportunities for hunters since the population of

predominant game species such as deer and elk will be decreased due to reduced food supplies. The reduction in the diversity of animals due to the elimination of the "edge effect" created by cutting practices will adversely affect some naturalists and birdwatchers. On the other hand, opportunities will be available to observe relatively unique species or habitat associated with unharvested forests. Reduced road construction will prevent vehicular access to many areas thereby minimizing or precluding some recreational uses and the development of facilities such as campgrounds and picnic areas.*

Many of the recreational related environmental impacts are offsetting as far as the various public user groups are concerned. However, this alternative will probably be most favorable to those segments of the public who enjoy the non-commodity values or non-intensive uses of the forest such as hikers, naturalists and wilderness seekers.

5. Soils. Soils will be stable as a result of little surface disturbance and erosion will be limited to localized areas where natural slides or slumps occur. Soil compaction will be localized to relatively small areas subjected to intensive human use. Any road construction for the purpose of providing public access or means for transporting private timber will continue to represent the major impact on soil stability.

---

*The assumption that fewer roads will be built is based on the fact that the cost of this activity is, in most cases, carried by the timber sales program.

6. Vegetation. This alternative will result in the preservation or creation, over time, of forests comprised primarily of overmature stands of trees. Whereas current timber management objectives eventually call for the harvest of crop trees ranging from 70 to 120 years of age, no timber cutting would result in many trees reaching ages of 300 to 500 years and older at which time natural mortality would occur and regeneration would begin. The pathological or natural rotation will result in a significant reduction in the growth of one of its dominant components - wood. For example, an acres of trees harvested over five successive rotations of 100 years each will grow two to three times as much wood material as found on an acres of 500 year old trees. There will be a long-term trend towards climax types of vegetation which represent the mature or final stage in succession. This evolution will eventually produce, on some sites, vegetative types far different than now exist. Generally, climax vegetation is more tolerant and stable and their closed canopies will eliminate considerable vegetation from the forest floor due to competition for sunlight, moisture, and nutrients. Consequently, the Douglas-fir trees that predominate in western Oregon and in other regions would be eventually replaced with smaller sized true-fir and hemlock trees.

Individual and groups of dead trees will be common. Their deterioration, along with windthrown trees will result in a large amount of debris on the forest floor. This in conjunction with general stand decadence, will increase the susceptibility of the forest to fires, insect infestations and disease with attendant control measures hampered in unroaded areas.

7. Water. The closed forest canopies will reduce water yields, particularly from snow zones and from watersheds where summer rainfall constitutes a significant portion of total annual precipitation. Flood and other runoff peak levels will generally be reduced. Water quality would be the highest naturally obtainable, however, the eutrophication of inland waters and estuaries would continue as a result of natural soil erosion. Water temperatures would also be generally the lowest obtainable under natural conditions.

8. Wilderness Experience. The absence of commercial timber operations will perpetuate or create, over time, the elements generally associated with the enjoyment of wilderness values. Many of the vast and undeveloped forest of interior Alaska could qualify as candidates for inclusion in the formal wilderness area system. However, even with the eventual erasure of the signs of timber management activities from the other Bureau administered forests, it is doubtful that most forest areas would qualify as wilderness under present legal criteria, primarily because of the development of the intermingled private lands.

9. Wildlife. The elimination of thinning and harvesting practices on approximately 110,000 acres annually will have an adverse impact on those wildlife species which requires low vegetation as a source of food or habitat. Consequently, reductions in the populations of such animals as deer, elk, rabbits, band-tailed pigeons and ruffed grouse can be expected. On the other hand old growth forests will support greater populations of small birds, squirrels, insects and other organisms that inhabit the high foliage canopy or the soil. The existence of snags and deadtop trees will improve the habitat for such wildlife as eagles, hawks, owls and woodpeckers by serving as nesting and perching sites and as food sources. Furthermore, the undisturbed forest will provide more suitable habitat for species which are particularly sensitive to human activities such as the spotted-owl, lynx or marten. Generally, however, the more uniform canopy cover of the undisturbed forest, having less "edge" between different vegetative types of canopies, will tend to produce a lesser variety of both flora and fauna than a forest under timber management.

In general, high water quality will be maintained with resulting benefits to aquatic wildlife. Due to reduced surface run-off, stream sedimentation will be generally limited to natural eutrophication thereby helping to stabilize the habitat of fish and aquatic organisms. However, stream debris, in the form of windthrown and fallen decadent timber, will increase and in some instances will result in inaccessible barriers that inhibit the passage of anadromous fish such as salmon and steelhead.

10. Socio-Economic. The local socio-economic consequences of this alternative will be the severest in western Oregon where the annual production of approximately 1.2 billion board feet represents 17 percent of the total that the region produces. Approximately 13,500 primary timber related jobs and 20,000 secondary jobs (retail trade, service, etc.) would be lost. These jobs represent 8 percent of the total employment in the region but range as high as 35 percent in some local areas. The impact in Alaska would be inconsequential while in the other states the production foregone in the amount of about 150 million board feet would involve the loss of some 2,000 primary and secondary jobs. While some opportunities for geographic relocation and other sources of employment may be available it can be expected that mostly unemployment with its attendant social and economic hardships to individuals and communities will result. This will be slightly offset by the accompanying reduction in industrial accidents and their corresponding social and economic costs.

At the national level the annual timber production foregone in the amount of 1.3 billion board feet, representing 3 percent of total U.S. softwood production, will widen the existing and projected gaps between supply and demand. Since Bureau-produced timber is primarily processed as lumber and plywood for housing purposes, approximately 100,000 less housing units would be constructed each year unless other sources or types of material were made available (these are discussed in subsequent sections). Furthermore, a reduced supply of raw material can be expected to increase timber prices thereby increasing housing costs. The revenue foregone to the U.S. Treasury and applicable local governments from the sale of timber will total about $200 million annually while the savings in the annual appropriations necessary to carry out the program will be about $20 million dollars, based on 1974 levels.

The socio-economic impacts of a no-timber management program could conceivably, be offset in part by any gains in non-timber related forest uses and values, such as increased recreational use. These could stimulate or increase corresponding forms of economic activity, however, the net effect could be expected to be a significant decrease in employment and gross national product.

Finally, the impact of this alternative as it relates to the legal requirements for the multiple use management of the public lands would require exploration, and if necessary, the applicable laws changed.

11. Summary. The environmental impacts of the no timber program alternative are summarized below to provide the reader a capsule view and also a ready comparison with a similar display of impacts shown for the program in Chapter I and the limited program alternative shown in the next section of this chapter.

Environmental Component	Impact	Magnitude
Aesthetics and Human Interest	Favorable	Major
Air	Favorable	Minor
Ecological Interrelationships	Favorable	Minor
Recreation (general)	Favorable	Minor
Recreation (fishing)	Favorable	Minor
Recreation (hunting)	Adverse	Minor
Soils	Favorable	Minor
Vegetation (health and vigor)	Adverse	Major
Vegetation (diversity)	Adverse	Minor
Water (quality)	Favorable	Minor
Water (yield)	Adverse	Minor
Wilderness Experience	Favorable	Major
Wildlife (raptors, predators)	Favorable	Minor
Wildlife (herbivores)	Adverse	Minor
Wildlife (aquatic)	Favorable	Minor
Socio-Economic	Adverse	Major

B. Limited Timber Management Program

There are an infinite number of program levels under which a forest can be managed, along with a corresponding number of production levels. Any attempt to identify them all and describe their environmental impacts would be difficult at best and probably meaningless. Consequently, this alternative was selected because it falls somewhat mid-way between a no-timber management program and an intensive timber management program. It typifies the management of those forests where the objective is to produce a sustained-yield of timber but at a level consistent with minimal capital investments. Consequently, the practices included under this alternative are limited to (1) the cutting, logging, and transportation of mature trees, (2) road construction and maintenance and (3) protection.

The adoption of this alternative would result in a significant reduction in the intensity of the western Oregon program and its corresponding level of production. While a limited program generally approximates the current program for the remaining forests in the contiguous United States, its adoption would stem the trend towards more intensive management of the forests classified as available for timber production. The possibility for the adoption of this alternative for 99 percent of the undeveloped interior Alaska forests is largely academic since they are far removed from existing markets and are expected to remain economically inaccessible during the next 10 years.

One of the overall effects of the limited program alternative will be to minimize at any given point in time, the occurrence of the environmental impacts of timber management practices. Besides the obvious reason of this alternative being limited to considerably fewer practices, a second contributory factor is involved. Due to the reliance on natural regeneration for restocking (often requiring 10 to 15 years or longer than artificial regeneration) the number of years necessary for cut-over areas to produce crop trees, ranging from an average of 83 years in western Oregon to 120 years of age in the other regions, will be lengthened accordingly. As a result, the number of acres, cut and logged each year will be about 15 percent lower due to the reliance on natural regeneration.

A second overall effect of this alternative will be to minimize the frequency of the environmental impacts of timber related activities on a particular area over time, thereby providing a maximum period for the site to recover from any disturbance incurred. In forests under an even-aged system management a timber stand will be entered only once during its life time of about 100 years in the case of clearcutting or two to three times in the space of 10 to 30 years in the case of seed tree and shelterwood cuttings. Forests under a many-aged system of management may be subjected to selective cutting as frequently as every 20 years.

Combining the foregoing elements of geographic dispersion and frequency, and based on an average timber rotation of 100 years and a 50 year road development period, the total amount of forest land directly impacted each year by clearcutting (if applicable), logging and road construction practices under the limited alternative will be about 1 percent whereas it could eventually reach 12 percent under an intensive program. These percentages will be higher where stands are subjected to other cutting systems, however, the impact on individual cutting units will be less.

Road construction, acknowledged to be the most damaging practice in terms of soil erosion and stream sedimentation, would proceed slower under this alternative than under an intensive program level, thereby spreading out its impacts over time. Current road construction rates in western Oregon of 400 miles a year would be reduced to about 300 miles. This alternative, like the intensive program will result in a fully developed permanent road system occupying approximately 5 percent of the land base, however, the trend towards more far-reaching logging systems (helicopters, skylines, etc.) will probably reduce this percentage in the future.

Despite the mitigative measures employed in the course of land use and timber management planning, some of the public will be adversely effected because of the manner in which the practices under this alternative are carried out or by virtue of their being carried out at all. In this regard, there is little difference in the limited and current timber management program since both include to similar degrees two of the most controversial practices: clearcutting and road construction.

In the following discussion the environmental impacts of the limited program are compared to a no-timber program or the current program whichever is judged to be most meaningful.

1. Aesthetics and Human Interest. The adoption of this alternative will have its greatest impact on aesthetics in western Oregon as a result of reducing the acreage clearcut each year from 19,000 acres to approximately 13,000 acres. Nonetheless, the unsightly characteristics of this practice will continue to adversely impact the environment as perceived by some segments of the public to varying degrees and the reliance upon natural regeneration will extend their duration by 15 to 20 years. Increasing air travel can conceivably accentuate this impact. The noise and dust associated with cutting, logging and transportation practices will interrupt the serenity that is often sought in the forest. While infrequent, wildfires caused by timber management activities will occur and significantly impact aesthetic as well as other values. On the other hand, many unsightly dead stands of trees resulting from insect infestations and disease along with fire-killed stands will be harvested thereby improving aesthetic values. The replacement of old growth stands with young growth stands on lands available for timber production will adversely impact those people who enjoy the aesthetic values provided by large and aged trees. Because it is often difficult to locate archeological sites or to recognize some sites, an occasional site may be sometimes destroyed.
2. Air. The present impact of the prescribed burning of logging debris on air quality will be further minimized with the reduction of the acreage treated from 9,000 acres annually to 6,000 acres. The resulting smoke will sometimes constitute a minor nuisance to local inhabitants during a few months of the year, principally in western Oregon.

3. Ecological Interrelationships. Over time, the ecosystem of all lands available for timber production will continue to be impacted since every acre will be disturbed to some degree. The ecosystem of a particular area will be effected on a cyclic basis - once every 100 years, on the average, when harvesting operations take place. As a result there will be impacts on components of the ecosystem resulting from soil erosion, stream sedimentation, and vegetal destruction on individual areas throughout the forest every year, ad infinitum. The basic ecological processes relating to nutrients, water and energy will recover within 1 to 5 years on most areas due to natural renewable means and in the total forest community a man-nature induced equilibrium will be established and maintained. However, due to human errors and natural phenomena, there will be continuing instances where the ecosystem of small localized areas will be so severely impacted that recovery will not take place within decades from the time the impact occurred.

The general character of the ecosystem will be significantly changed by the replacement of the old growth stands (200 years in age and older) with young growth stands (100 to 120 years in age and younger) on lands available for timber production. The number of years necessary to make this transition would vary between 35 years for western Oregon and 50 to 60 years for the remaining States.

Consequently, the gradual reduction in the extensiveness of the old growth ecosystem will be inevitable along with its attendant biotic community. While some members of the community may be capable of relocation to old growth stands not subject to cutting or be adaptable to young growth forests, others will be reduced in number or distribution.

4. Recreation. The occasional reduction in the water quality of streams and lakes due to logging and road construction practices will continue and serve as a detriment to fishermen, swimmers and boaters. Any general recreational use of specific areas will be temporarily disrupted during the period that timber operations are carried out on the area.

The edge effect resulting from harvesting practices will provide excellent habitat for many wildlife species. As a result, increased populations of game animals such as deer and elk will be beneficial to hunters while a wide variety of flora and fauna will benefit many birdwatchers and naturalists.

Log truck traffic will represent a hazard to public safety and the accompanying dust will be a nuisance to people on or alongside routes of travel. On the other hand, roads built for timber management purposes will provide ready access to many areas of the forest having various recreational values and uses which would otherwise be inaccessible to segments of the public.

While these roads will increase the risk of man-caused fires due to public negligence, they will at the same time, provide better access for the control of fires from all causes.

Like the alternative of no-timber management, many of the environmental impacts of this alternative are off-setting as far as the various public user groups are concerned. However, of the two, the limited program will probably be more favorable to the majority of that segment of the public who enjoy the commodity values of the forest such as hunters and fishermen and those who enjoy intensive use as provided by easily accessible camping areas and picnic sites.

5. Soil. Although this alternative would reduce road construction by about 100 miles annually, the construction of approximately 400 miles of road per year for the next 40 years will continue to represent the severest impact of any practice on the soil. In the course of developing the road networks severe vegetal disturbance in conjunction with earth movement will result in localized soil erosion, compaction and occasional mass movements. Logging practices conducted on 60,000 acres annually will contribute to a lesser degree to further localized mass wasting, compaction and soil erosion due to water and wind forces.

6. Vegetation. The productivity of the forest biomass will be relatively high in terms of annual wood growth when compared to the overmature nature of unharvested forests but considerably lower than intensively managed forests. Maximum productivity will not be achieved because of such factors as the delay or failure of natural tree regeneration on many cutting units, losses due to insects and disease and the sub-optional utilization of growing space where timber stands are successfully established.

The natural succession of forest vegetation from pioneer to climax species will be interrupted and in most instances forestalled. To the extent possible, cutting practices will be used that tend to favor the creation of stands of commercially desirable tree species as opposed to the natural succession of species which occurs under the no program alternative. Cutting practices along with logging and road construction practices will result in severe vegetal destruction and disturbance.

7. Water. Compared to the no-timber management program alternative there will be an increase in peak flows from fall and spring storms but to a lesser degree during heavy mid-winter precipitation, as characterizes western Oregon, since both forested and cut-over areas are saturated at this time.

Surface run-off on disturbed areas, principally on those involving road construction activities, will accelerate to a minor degree the natural rate of eutrophication of water bodies. Occasional mass soil movements will result in above normal sedimentation thereby degrading water quality. However, the impact on its currently limited use for human consumption will be nominal or nonexistent. There will be instances where clearcutting will temporarily increase water temperatures due to increased exposure of small tributary waterways to solar radiation. Also, logging debris will temporarily decrease the dissolved oxygen content of streams. Nonetheless, water quality in terms of temperature and oxygen content will remain at a near normal level.

8. Wilderness Experience.

The construction of roads along with timber harvesting activities will result in the alteration of natural undeveloped forests which, in turn, will destroy any wilderness type values that are often associated with "virgin" old growth forests. Although there will be old growth forests not available for timber production, their extensiveness will be significantly diminished thereby adversely affecting some elements of the public.

9. Wildlife.

Nearly all wildlife will be initially affected adversely by the impact of timber harvesting and road construction activities. The removal or destruction of habitat including nesting and escape cover will result in some displacement or actual loss of wildlife. This sudden impact will be of a relatively short duration, however. Deer, elk, rabbits, band-tailed pigeons and ruffed grouse will respond favorably to the removal of timber and the subsequent increased availability of nutritious browses, grasses and forbs. Rodents, including ground dwelling squirrels and mice, will increase in numbers due to brush regeneration following logging. Consequently, small predators that prey on these rodents will also benefit. On the other hand, owls and most raptors and predators will be adversely effected as a result of the impact of timber harvesting on their habitat requirements. The land area occupied by roads will permanently remove 5 percent of the land base from wildlife habitat, encourage harassment of wildlife through ease of vehicular access and reduce the area available to wilderness inhabiting species.

Natural regeneration of cut-over areas in conjunction with the "edge effect" created by harvesting practices will result in a more diverse habitat that, in turn, will produce a greater variety of birds and mammals.

Aquatic habitat and wildlife will continue to be adversely impacted due to sedimentation and slides emanating principally from road construction activities. Logging debris will occasionally block streams and dependent upon the time of year, interrupt or hamper the migration of anadramous fish such as salmon and steelhead. In general, however, the accessibility provided by roads to fishermen represents the only potential significant impact on aquatic wildlife populations.

10. Socio-Economic.

The local socio-economic impacts of a limited timber management program would have its greatest impact in western Oregon. The current annual production of 1.2 billion board feet from Bureau administered lands in this region would be reduced by about 35 percent resulting in the loss of some 12,000 primary and secondary timber related jobs. Because of the variation in the dependency of local western Oregon communities on Bureau timber, some will be affected by as much as a 12 percent reduction in employment. While opportunities for geographic relocation and other sources of employment may be available, it can be expected that unemployment with its attendant social and economic hardships to individuals and communities will result. At a national level, the annual timber production foregone as a result of an approximate 400 million board feet reduction in western Oregon would widen the existing and projected gap between supply and demand with attendant increased prices of material and in turn, housing. The revenue foregone to the U.S. Treasury and applicable western Oregon counties will total about $70 million annually, based on the 1974 value of timber sold.

Any geographic expansion of the current or projected program in interior Alaska will provide for increased employment and help stimulate other forms of economic activity in the course of developing the region. However, the possibility of this occurring within the next 10 years is highly doubtful since the forests are isolated and economically feasible means are not available for transporting the raw material to manufacturing or marketing centers.

The adoption of a limited program will dampen the thrust of the program projected for the remaining forests during the next decade. Since the programs for these forests are currently undergoing revision it is difficult to quantify the impact of this alternative. Nonetheless, a reduction in timber production of approximately 25 percent or about 35 million board feet annually could be expected with the attendant loss of some 500 primary and secondary related jobs. While the production foregone could be judged insignificant the reduction would contribute further to the overall impact of this alternative on decreased supply and increased product prices.

11. Summary.

The environmental impacts of the limited program alternative are summarized below to provide the reader a capsule view and also a ready comparison with a similar display of impacts shown for the program in Chapter I and the no program alternative shown in the preceding section of this chapter.

In analyzing the following impacts the reader should keep in mind that some individual timber management practices may have a different kind or magnitude of impact on an environmental component than the aggegated impact shown for the limited program. Also, some elements comprising an environmental component may be impacted in a different manner or magnitude than indicated for the environmental component listed.

Environmental Component	Impact	Magnitude
Aesthetics and Human Interest	Adverse	Major
Air	Adverse	Minor
Ecological Interrelationships	Adverse	Minor
Recreation (general)	Adverse	Minor
Recreation (fishing)	Adverse	Minor
Recreation (hunting)	Favorable	Minor
Soils	Adverse	Minor
Vegetation (health and vigor)	Favorable	Minor
Vegetation (diversity)	Favorable	Major
Water (quality)	Adverse	Minor
Water (yield)	Favorable	Minor
Wilderness Experience	Adverse	Major
Wildlife (raptors, predators)	Adverse	Minor
Wildlife (herbivores)	Favorable	Major
Wildlife (aquatic)	Adverse	Minor
Socio-Economic	Favorable	Major

C. Other Timber Harvesting Practices

While the two foregoing sections dealt with program alternatives i.e., no program and a limited program, this section deals with an alternative relating to the modification of the mix of cutting practices to be employed in carrying out the current program. As such, it represents a sub-program alternative that concerns itself with how the program is to be carried out and not at what level or intensity. Basically, this alternative requires the cessation of all clearcutting except for road construction purposes and the salvage of dead stands of timber due to fire, insects, disease or windstorms.

Currently, the choice of the appropriate cutting practice is dependent upon silvicultural, environmental and economic considerations. In actual practice, all three elements enter into the cutting prescription developed by an interdisciplinary resource team for a given timber stand. On lands available for full timber production, the overriding criterion for the selection of clearcutting is that a high probability exists for the successful establishment of commercial tree species on the area following logging and their subsequent optimum growth. Consequently, clearcutting is essentially limited to the high-rainfall and highly productive Douglas-fir region of northwestern Oregon. This is evidenced by the fact that 17,500 of the some 20,000 acres to be clearcut each year are located in this region.

Areas to be clearcut are distributed throughout the forest each year on areas 10 to 40 acres in size (except where catastrophic losses occur) averaging 30 to 35 acres.

The assumed substitute for clearcutting in this alternative is a three phase partial or shelterwood cutting system which is currently employed to a large extent in southwestern Oregon and in the other states. This practice is usually carried out where site conditions are such that a forest canopy must be maintained until tree regeneration is successfully established. It involves the removal of approximately 20 to 30 percent of the stand volume during the initial entry and subsequently removing the remainder over two more entries primarily at 15 year intervals. While there are many alternative harvesting systems this system was selected since it is technically feasible for most stands in northwestern Oregon and its application would minimize the major adverse impact often attributed to the practice of clearcutting on aesthetic values.

Based on the premise that the current annual production of 1.3 billion board feet is to be maintained for the current decade, the cessation of clearcutting would require increasing the projected mature timber acreage to undergo partial cutting from 70,000 acres to approximately 130,000 acres each year in order to make up for the 900 million board feet normally clearcut each year. Practically all of the increased cutting would be in northwestern Oregon in order to maintain current production levels consistent with the principle of sustained-yield.

Since the timber management practices of the current program would essentially remain the same under this alternative, with the exception of clearcutting, their environmental impacts as described in previous chapters will not be repeated. Instead only incremental changes stemming from increased partial cutting primarily in northwestern Oregon, will be described.

1. Aesthetics and Human Interest. The unsightly characteristics associated with clearcutting will be localized to areas which have been subjected to the salvage of dead or dying timber. The adverse visual impact of roads will be increased due to the acceleration of road construction needed to gain access to a portion of the 60,000 additional acres to be partially cut each year in lieu of the 20,000 acres currently planned for clearcutting. However, this will be partially offset by their general lack of visibility from a distance due to the absence of clear cut areas adjacent to the roads. The increased logging debris remaining on the forest floor following partial cutting, as compared to clearcutting; will heighten the risk and also the difficulty of controlling wildfires and, therefore, increase their attendant impact on aesthetic and other values.

2. Air. The cessation of clearcutting will almost totally eliminate the burning of logging debris and, in turn, the release of particulates in the air and the nuisance of smoke to the public during the fall months.

3. Ecological Interrelationships. The transition period from an old growth to a young growth ecosystem will be lengthened from 25 years to a minimum of 30 years in northwestern Oregon. The number of acres disturbed each year by the cutting of mature timber will be tripled where partial cutting replaces clearcutting. The impact on the ecosystem of individual areas will be lessened due to the removal of only a part of the standing trees, however, the ecosystem will be disturbed three times over the space of a 30 year removal period. Generally, the impact of partial cutting on the ecosystem over time will be less than that of clearcutting. The adverse impact of road construction practices on the basic ecological processes, in the form of soil disturbance and vegetal destruction, will be increased due to the accelerated road construction needed to gain access to unroaded areas to be subjected to partial cutting. It is estimated that the current annual rate of 400 miles of road construction in western Oregon would have to be increased to approximately 650 miles annually during the decade.

4. Recreation. The occasional reduction in the water quality of the lakes and streams, primarily in the form of sedimentation, will be increased by the accelerated road construction thereby adversely impacting fishermen. Hunters will be adversely impacted by lesser populations of game species such as black-tail deer, elk, and band-tailed pigeons as a result of the reduction in the availability of food supplies when under a partial cutting system as compared to a clearcutting system. The volume of log truck traffic will remain relatively the same, however, the attendant noise and dust will be distributed over a larger area. Accelerated road construction will increase vehicular accessibility to a greater portion of the forest for the public to enjoy.

5. Soil. The additional 250 miles of road to be constructed each year during the decade will further increase the localized soil erosion, compaction and occasional mass slides broght on by severe vegetal disturbance and earth movement. Soil erosion stemming from cutting and logging on given areas will be lessened with the elimination of clearcutting but will be partially offset by the partial cutting of three times as much area as is clearcut each year. The leaching of soil nutrients on cutting units will be reduced due to the increased litter on the forest floor as a result of partial cutting.

6. Vegetation. The maintenance of a relatively closed canopy for a 30 year period will increase the natural regeneration of such tolerant species as western hemlock, cedar, and vinemaple. Along the coastal area there will be a significant increase in shade tolerant shrubs and herbs.

The productivity of the forest in terms of net annual wood growth will decrease during the transition to a young growth forest since the replacement of slow growing old growth stands by faster growing young growth stands will be delayed by at least 5 years. In conjunction with this, the necessity for carrying the old growth forest for at least 30 years under the partial cutting system as compared to the 25 years called for in the program will result in less annual volume being available for harvest during the transition period. This will be partially offset by the earlier harvest of some dead and dying trees, the volume of which would otherwise be lost, during the initial entry under a partial cutting system. Increased windthrow, particularly following the second entry, and increased insect infestations and disease resulting from old growth logging debris would further decrease annual wood growth. Because of the foregoing factors, it can reasonably be expected that the annual production of wood in northwestern Oregon will be less, by an undeterminable amount, during the transition period under a partial cutting system.

7. Water. The net result of decreased clearcutting and accelerated road construction will be to increase sedimentation stemming from surface erosion and mass soil movements, thereby decreasing water quality. The risk of the introduction of chemical toxicants into waterways will be heightened by the increased use of herbicides to control the increased encroachment of brush on cutting units. Water temperatures will be closer to normal due the maintenance of a forest canopy over small tributary streams. Water yields will be decreased somewhat as will peak flows from fall and spring precipitation.

8. Wilderness Experience. The accelerated road construction would increase the development of the forest thereby increasing the rate of the destruction of wilderness-type values.

9. Wildlife. The initial adverse impact of timber cutting on terrestrial wildlife populations and habitat will be lessened by the gradual removal of trees over a 30 year period, thereby facilitating their relocation or adjustment. While the increase of vegetative browse species in some areas will benefit deer and elk in those locales, the overall impact will be to reduce their total populations because of lower food supplies. On the other hand, a partial cutting system will provide more uninterrupted protective cover. The "edge effect" will be dampened to some degree, thereby reducing the diversity of flora and fauna.

Ground burrowing mammals will generally be adversely impacted on a long-term basis while high-canopy species such as hawks and owls will temporarily benefit. Accelerated road construction will increase the harassment of all forms of wildlife through public and vehicular access.

The adverse impact of sedimentation or aquatic habitat and wildlife will be increased due to accelerated road construction. However, the maintenance of more normal water temperatures will be beneficial. The risk of accidental spills of chemical toxicants into waterways will be heightened, by the increased use of herbicides for brush control, thereby increasing the possibility of aquatic wildlife mortality.

10. Socio-Economic. The substitution of partial cutting for clearcutting will cause some economic dislocation for the logging industry. In addition to the need for the acquisition of additional or specialized equipment by some firms, the fixed-cost of equipment will be more difficult to amortize since they will be operated over a larger area and on an increased number of yarding and loading points. In this regard, logging costs will increase due to lower harvest volumes per acre causing stumpage values to be lower which in turn, can be expected to result in an undeterminable decrease in revenue from timber sales. At the same time, program costs will increase as a result of the additional time needed to prepare and administer partial-cut sales. The increased costs of successfully

establishing and maintaining new stands due to brush encroachment following cutting on some areas will also increase program costs.

While the foregoing impacts are based on the continuation of the current annual production of 1.3 billion board feet the substitution of partial cutting for clearcutting would require a temporary reduction in the annual production at some point in time due to the factors identified under the vegetation component. Consequently, whenever this reduction was made other socio-economic impacts such as reduced employment and supply and a further reduction in timber sales revenue would result. However, if the reduction was initiated within the decade, the environmental impacts identified with accelerated road construction under this alternative would be lessened due to the reduction in the number of acres undergoing partial cutting each year.

11. Summary. The environmental impacts summarized below are set forth as to how they relate to the program. For example, the favorable impact ascribed to this alternative on aesthetics is due to partial cutting instead of clearcutting and does not mean that partial cutting, in itself, has a favorable impact on aesthetics.

Environmental Component	Impact	Magnitude
Aesthetics and Human Interest	Favorable	Major
Air	Favorable	Minor
Ecological Interrelationships	Favorable	Minor
Recreation (general)	Favorable	Minor
Recreation (fishing)	Adverse	Minor
Recreation (hunting)	Adverse	Minor
Soils	Adverse	Minor
Vegetation (health and vigor)	Adverse	Minor
Vegetation (diversity)	Adverse	Minor
Water (quality)	Adverse	Minor
Water (yield)	Adverse	Minor
Wilderness Experience	Adverse	Minor
Wildlife (raptors, large predators)	Favorable	Minor
Wildlife (herbivores)	Adverse	Minor
Wildlife (aquatic)	Adverse	Minor
Socio-Economic	Adverse	Minor

NOTE: The above impacts are on a short-term basis i.e., within the next several decades. On a long-term basis there would be no difference between many of the environmental impacts resulting from the program and this alternative.

D. Other Domestic Wood Production

The three major administrators or owners of the 500 million acres of forest land currently classified as suitable and available for timber production in the United States are the Forest Service, private industry and private non-industry sectors. [1]

Common to all three ownerships is their capability to offset any loss of Bureau production through improved timber utilization. Although considerable progress has been made in this area, an estimated 1,594 million cubic feet of logging residues were left in the woods unutilized in 1970. Unsalvaged mortality of widely scattered trees killed by fire or other destructive agents totaled an estimated additional 4.2 billion cubic feet. In addition, an estimated 993 million cubic feet of manufacturing residues were burned or discarded in the same year.[2] While these statistics include Bureau administered forests, any advances in better utilization would result in proportionately much greater increases in production from the three major non-Bureau lands since they represent approximately 92% of the commercial forest land base.

Forest Service

The national forests comprise approximately 92 million acres or 18% of the total commercial forest land and are primarily located in the western United States.[3] The western national forests are similar to Bureau administered forests in terms of composition and age in that overmature coniferous stands predominate. As a result, any potential increase in production from these lands could be readily utilized as a substitute for foregone Bureau production in existing structural material and miscellaneous markets. The national forests are also similar to many Bureau administered forests in respect to having an immediate biological potential for increased timber production if adequate funds and manpower were available to intensify current programs. A recent Forest Service Study indicates that under assumed levels of management the increase production from the national forests could immediately more than offset the total elimination of the 1.3 billion board feet produced annually from Bureau administered lands. The environmental impacts of the individual practices and collectively under an intensive program on any given national forest would be essentially identical to those described in the previous chapters.

Industrial Forest Lands

Forest industries own approximately 67 million acres or 14% of the total commercial forest land and are located primarily in the southern and eastern parts of the United States.[4] Substantial progress has been made in this sector in raising the level of timber management during recent years as a result of increased funding of reforestation and other silvicultural practices. Surveys of forest industry holdings in the south, for example, indicated that with the current practices and investment levels, most industry lands in this region will be under intensive management by 1980.[5] While there are some opportunities for further intensification, industry lands are generally at a relatively high level of timber management. Concurrently, the industry lands in the Pacific Coast and Rocky Mountain regions are being rapidly depleted of old growth sawtimber inventories and projections indicate that sawtimber production from these lands can be expected to decrease through the year 2020.[6] Because of the foregoing factors, it is highly improbable that industry lands would be capable of offsetting any reduction in the production of sawtimber from Bureau Administered lands at a regional or national level, either now or in the reasonable near future, unless short term accelerated cutting of sawtimber was acceptable at the cost of additional future reductions.

Non-industrial Private Lands

Non-industrial owners hold approximately 296 million acres of commercial land, representing about 60% of the total, located primarily in the southern and eastern parts of the United States.[7] These owners consist of farmers, businessmen, housewives, power companies and numerous other occupational groups having widely divergent interests or capabilities to invest funds in timber growing. In reporting on their objectives in owning forest lands, a survey indicated that a minority of the non-industrial private owners sampled had as their principal objective, timber production. Most owners indicated that recreation, wildlife protection, aesthetics or speculation were their principal goals. Most had little interest in making sizable investments in timber growing and some owners were reluctant to harvest timber.[8] These attitudes are supported by the fact that only a small minority have participated in various assistance programs of Federal, State and private agencies to intensify the management of their lands. A general conclusion drawn from the survey results is that most owners do not consider timber growing investments to be sufficiently profitable to take priority over other investment of consumption opportunities.[9] Nonetheless if the non-timber producing segment of this ownership class could be motivated by increased financial assistance, informational and educational programs or by changes in the economic situation relative to investment profitability, their potential for production can be increased. A recent Forest Service Study indicated that 12.7 million acres of non-industrial forest land, meeting specified criteria for intensification of management, could as a result of cost-sharing or other incentives produce an additional 50 billion board feet over the next 50 years. However, harvest increases would be less than 100 million board feet a year for the next 15 years.[10] Consequently, even under somewhat optimistic conditions, the potential for the lands in this ownership class to significantly replace any foregone production from Bureau lands in the near future appears to be somewhat limited.

E. Wood Imports

Over the last two decades imports of wood products have risen to the point where they now comprise one-fifth of the total supply of industrial wood in the United States.[11] Of this amount, softwood imports reached 5.9 million board feet and accounted for almost 18% of lumber supplies and 29% of pulp and paper supplies in 1970. Most of the imported softwood has been in the form of lumber coming primarily from Canada. Recent Forest Service projections indicate substantial future increases in Canadian timber product exports to the U.S., particularly if domestic timber prices show appreciable gains. To immediately replace the foregone production of 1.3 billion board feet from Bureau administered forests would require an increase of Canadian imports of 25% over current levels. About the only other possible source for significant additions to softwood imports is the U.S.S.R., however, increasing domestic needs coupled to declining resource availability in European Russia suggest that it is unlikely to become a major supplier of foreign markets in the near future.

The rest of the world forests are either predominantly hardwoods, i.e., Asia, Africa and Latin America, or the softwood forests are already heavily utilized. Whether a rise in U.S. imports of either softwoods or hardwoods can be achieved will largely depend on developments in the world timber supply-demand situation, and the economic availability from other countries, primarily Canada and tropical areas such as Southeast Asia.[12] However, any increase of imported wood will add to the balance of payments dificit which reached a record level of $6.4 billion in 1972.

Regardless of the source of any potential increased imports, the most significant impact of this alternative would be the loss of the value to the U.S. economy generated by the processing of domestic sawtimber into lumber and other products in American mills. This would amount to over $200 million annually. While the importation of logs for domestic processing would preclude this loss, it is doubtful if Canada or other propective nations would be willing to export part of their economic base.

Relative to a prospective increase of imported wood to offset any foregone domestic production is the alternative of decreased U.S. wood exports. During the decade of the 60's almost 3 billion cubic feet of logs were shipped to other countries, mainly to Japan, for manufacture.[13] In 1970, 2.8 billion board feet in logs and 1.3 billion board feet of lumber were exported to foreign markets.[14] The reduction or cessation of this activity could more than offset any loss in production from Bureau administered forests. However, this alternative would further aggravate the balance of payments deficit and result in some domestic economic dislocations along with the matter of its international implications.

F. Substitute Materials

The consumption of all major categories of industrial raw materials including wood, mineral and agricultural products has increased since 1900. There have, however, been some substantial shifts in the relative importance of the various materials. For example, between the early 1900's and the mid-1950's there was a decline in the relative importance of timber products, with the value of timber products falling from about 45% of the industrial raw materials consumed to around 20%. Since the mid-1950's, however, there has been little change with consumption of timber products accounting for about 20 percent of all industrial raw materials used.[15]

Since the decline in the relative importance of industrial timber products in the first five decades of the century was presumably related to relative price changes, the foregone annual production of 1.3 billion board feet from Bureau administered forests could be expected to result in further slippage in the use of timber products due to increased relative costs and decreased timber production. Unless offset by increased timber production from other sources, increased substitution by competing materials such as metals, plastics and concrete could be expected to ensue. Considerable substitution of this nature has, of course, occurred in the past. Mineral-based products and steel have made heavy inroads in many traditional wood markets such as the use of plastics for boats, furniture and packaging and, to a lesser extent, steel framing and aluminum siding in housing construction. Technologically, substitute materials could completely replace all current structural uses of wood although the aesthetic values of wood could prove difficult to simulate or replace.

The increased production of many substitute materials to offset reduced timber production will increase the activities and hence the environmental impacts associated with mining, extracting and manufacturing processes on air, water and land. Generally, the adverse environmental impacts stemming from the manufacture of steel, aluminum and concrete products in terms of air and water pollution are of greater magnitude than those resulting from the manufacture of lumber and plywood products. In addition, the consumption of electrical energy to produce such materials as steel, concrete, and aluminum will be increased thus adding to the current energy shortage. As an example, 39,620 Kilowatt-hours are used to produce a ton of aluminum while 936 Kilowatt hours are used to manufacture a ton of lumber. There are likewise substantial differences in heating and cooling costs between houses built with alternative materials. Recent reports indicate that the energy needed to head a wood frame house is 23% below that required for a masonary house and 16% less energy for cooling purposes.[16] In view of the costs and capacity for producing energy to manufacture substitutes and the attendant impacts on air, land and water, such differentials as previously mentioned must be considered to be environmentally, economically, and socially significant.[17]

Among other aspects of the question of substitution is the increasing problem of waste disposal. Many substitute materials are not biodegradable and any additional replacement of highly biodegradable wood products will further aggravate this problem. Finally, the rate of depletion of non-renewable supplies of mineral ores, coal, petroleum and natural gas will be increased with attendant increased dependency on foreign sources for certain of these materials. Forests, on the other hand, constitute a renewable resources that can continue to produce wood indefinitely.[18]

Bibliography

1. Forest Services, U.S.D.A., The Outlook for Timber in the United States (Review Draft), Dec. 5, 1972, Chap. 1, pg. 3.

2. *Ibid.*, Chap. 3, pg. 67.

3. *Ibid.*, Chap. 1, pg. 10.

4. *Ibid.*, Chap. 1, pg. 12.

5. *Ibid.*, Chap. 3, pg. 17.

6. *Ibid.*, Chap. 2, pg. 111.

7. *Ibid.*, Chap. 1, pg. 9.

8. *Ibid.*, Chap. 3, pp. 12, 13.

9. *Ibid.*, Chap. 3, pg. 16.

10. *Ibid.*, Chap. 3, pg. 35.

11. *Ibid.*, Chap. 4, pg. 1.

12. *Ibid.*, Chap. 4, pg. 7.

13. *Ibid.*, Chap. 4, pg. 5.

14. *Ibid.*, Chap. 4, pg. 6.

15. *Ibid.*, Chap. 5, pp. 193, 194.

16. *Ibid.*, Chap. 6, pg. 12.

17. *Ibid.*, Chap. 6, pg. 14.

18. *Ibid.*, Chap. 6, pg. 15.

IX. CONSULTATION AND COORDINATION WITH OTHERS

The preliminary draft of the Timber Management Environmental Impact Statement was written in Portland, Oregon, during December 1972 and January 1973. An interdisciplinary team of BLM personnel representing expertise in the fields of forestry, fisheries biology, hydrology, civil engineering, geology, wildlife biology, regional planning, economics, range management and soils prepared the preliminary draft. Consultation was made with individuals in the Pacific Northwest Forest and Range Experiment Station, USFS; Region 6, USFS; Oregon State Office, BLM; and Montana State Office, BLM, in the course of preparing the draft.

The preliminary draft was circulated for comments to BLM State Offices in Alaska, Arizona, California, Montana, Nevada, New Mexico, Oregon, Utah and Wyoming. Comments were also solicited from the BLM Washington Office, BLM Boise Interagency Fire Center, BLM Denver Service Center, USFS Washington Office, USFS Region 6 Office and the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Based on the comments received a second draft was prepared during the fall of 1973 by the Division of Forestry, BLM Washington Office. This draft was circulated to elements of the BLM Washington Office and the Office of the Solicitor, U.S. Department of the Interior. Their comments were incorporated in this draft statement.

This document shall be distributed to the following agencies, organizations, academic institutions, industrial corporations and trade organizations for their comments:

Internal Review (BLM)

Offices in Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Wyoming, Denver Service Center, Eastern States Office and Washington.

Other Federal Agencies

Environmental Protection Agency, Department of Agriculture, Department of Health, Education and Welfare, Department of Defense, Department of Commerce, Department of Housing and Urban Development, Bureau of Outdoor Recreation, National Park Service, Bureau of Indian Affairs, Bureau of Reclamation, U.S. Fish and Wildlife Service, and Council of Environmental Quality, Advisory Council on Historical Preservation, U.S. Geological Survey, Bureau of Mines and Department of Transportation.

Organizations

American Forest Institute, American Forestry Association, Conservation Foundation, Environmental Defense Fund, Friends of the Earth, Isaak Walton League of America, National Audobon Society, Natural Resource Defense Council, National Wildlife Federation, Sierra Club, Society of American Foresters, Western University and Conservation Association, Federation of Western Outdoor Clubs, Resources for the Futures.

State Agencies

Department of Conservation, California; Department of Natural Resources and Conservation, Montana; Department of Environmental Quality, Oregon; Oregon State Department of Forestry; State Forestry Division, Wyoming; Department of Natural Resources, Washington; Department of Natural Resources, Alaska; Colorado State Forest Service and Idaho Department of Public Lands.

Academic Institutions

University of Washington, Oregon State University, University of Alaska, University of Montana, University of California, Berkeley, University of Idaho, Colorado State University, VPI, Syracuse University, and University of Wyoming.

Industrial Corporations and Trade Organizations

American Plywood Association, National Forest Products Association, Northwest Timber Association, Western Forest Industries Association, Weyerhaeuser Company, Georgia-Pacific, Boise Cascade, Potlach Forests, U.S. Plywood-Champion, Crown Zellerbach, Industrial Forestry Association, Western Wood Products Association and International Paper Company.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Table of Contents

.01 Purpose
.02 Objectives
.03 Authority
.04 Responsibility
.05 Definitions (Reserved)
.06 Policy (Reserved)

.1 Contract File Organization
    .11 Major Forest Products
    .12 Minor Forest Products

.2 Advertised Sales
    .21 Cruise Sales
        A. Contract Preparation
        B. Contract Provisions
            1. Timber Sold
            2. Time for Cutting and Removal
            3. Time for Removal of Personal Property
            4. Timber Reserved From Cutting
            5. Special Provisions
            6. Equal Opportunity in Employment
        C. Contract Exhibits
            1. Contract Map
            2. Road Construction Plans and Specifications
            3. Other Exhibits
            4. Miscellaneous Contract Documents
    .22 Scale Sales
        A. Scaling Standards and Requirements

.3 Cash Sale of Vegetative Resources

.4 Nonadvertised Sales
    .41 Negotiated Sale of Vegetative Resource (Under $100)

.5 Contract Numbering Procedure
    .51 Elements of Numbering System
    .52 Filing

Illustrations
    1. Timber Sale Summary (Form 5420-2)
    2. Section Diagram (Form 9180-30)
    3. Contract for the Cash Sale of Vegetative Resources (Form 5450-1)
    4. Vegetative or Mineral Material Negotiated Cash Sale Contract ($100 or less) (Form 5450-5)
    5. Equal Opportunity in Employment - Certification of Nonsegregated Facilities (Form 1140-3)

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Appendices

1. Preparation of Cruise Sale Contract (Form 5450-3)
2. Preparation of Scale Sale Contract (Form 5430-4)
3. Log Export Special Stipulation LE-1
4. Log Export Special Stipulation LE-2
5. Timber Reservation Provisions
6. Special Provisions

5424 - PREPARATION OF CONTRACT AND EXHIBITS

.5 Contract Numbering Procedure. A uniform system of contract numbering using an eleven-digit alpha-numeric number was installed on July 1, 1969. This numbering system is applicable to timber sale contracts executed on Forms 5450-3, 5430-4 and vegetative sales executed on Form 5450-1. (See Appendices 1 and 2, and Illustration 3.)

.51 Elements of Numbering System. Four elements make up the number:

A. Office Code. Use five digits to identify the office executing the document, followed by a hyphen. (See Bureau Manual 1321 for office codes.)

B. Document Type. Use a two-letter alphabetic code to identify the type of transaction. Codes are:

TS - timber sale (Forms 5450-3 and 5430-4)

VG - vegetative resource sale (Form 5450-1)

C. Fiscal Year Issued. Use one digit (the last digit of the year) followed by a hyphen.

D. Serial Number. Use up to four digits. Serial numbers revert to "1" each July 1. For example, a typical timber sale issued by the Boise District would be:

11010-TS1-101

.52 Filing. Documents are filed numerically according to serial number. A separate file and numbering system are maintained for each document type. A numerical index should be kept for each contract type, indicating the contractor's name and a brief description of the transaction.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

.01 Purpose. The purpose of this Manual section is to provide standard instructions in the preparation of contract forms used for the sale of timber and other vegetative resources. This section prescribes contract file organization, preparation of contract forms and exhibits, insertion of special stipulations, and completion of Timber Sale Summary, Form 5420-2.

.02 Objectives. The objective is to establish uniform contract preparation procedures and clearly written contracts which are understood by both the purchaser and the Authorized Officer.

.03 Authority. (5400.03)

.04 Responsibility.

1. Director. The Director, through appropriate WO staff officials, is responsible for the establishment of standard contracting procedures and development of contract forms.

2. State Director. The State Director is responsible for compliance with standard Bureau contracting procedures and the development of special stipulations to achieve forest management and environmental protection goals.

3. District Manager. The District Manager is responsible for the accurate and timely preparation of timber sale contracts and periodic training of personnel responsible for timber sale contract preparation.

.05 Definitions. (Reserved)

.06 Policy. (Reserved)

5424 - PREPARATION OF CONTRACT AND EXHIBITS

.1 Contract File Organization. Arrange each file in an orderly manner. Include all documents and correspondence pertaining to the timber sale contract.

.11 Major Forest Products. File documents in a six-way legal size folder for each parcel of timber offered for sale and arrange as follows:

A. Fasten to facing side of back cover:

1. Precruise data
2. Cruise and appraisal data

B. Fasten to back side of second leaf:

1. Presale correspondence
2. Sale information
3. Contract preparation correspondence
4. Presale checklist
5. Type map
6. Logging plan
7. Access map
8. Forest inventory depletion record

C. Fasten to facing side of second leaf all cutting reports and contract administration correspondence.

D. Fasten to back side of first leaf all copies of vouchers.

E. Fasten to front side of first leaf official documents or original carbons of:

1. Contract and exhibits
2. Modifications
3. Extensions
4. Assignments
5. Bond

5424 - PREPARATION OF CONTRACT AND EXHIBITS

.12 Minor Forest Products. File contract forms and back-up material on each sale of minor forest products, such as fence posts, ferns, manzanita, etc., in chronological order in a standard legal-size manila folder. Retain files in the district office for three years, then send them to the Federal Records Center. (See 1271, Appendix 1.)

.2 Advertised Sales. Prepare each timber sale contract to fulfill management plans and objectives.

.21 Cruise Sale. It is imperative that sufficient time is allowed for contract preparation to permit a thorough check of the contract, exhibits and appraisal.

A. Contract Preparation.

Responsible Office/Official	Step	Action
District Manager	1.	Completes Form 5430-3, Contract for the Sale of Timber - Cruise Sale. (See Appendix 1) Deadline for contract preparation is as follows: - Two weeks before sales of less than 10 million feet. - Four weeks before sales of over 10 million feet but less than 25 million feet. - Six weeks before sales of over 25 million feet.
	2.	Summarizes timber sale location, acreage, type of sale, contract period, volume, value, and appraisal data on Form 5420-2, Timber Sale Summary. (See Illustration 1.)
	3.	Attaches Form 5420-2 to the contract folder
	4.	Approves contract by surnaming. Orders advertisement and directs preparation of timber sale notice and prospectus when sale is less than 10 million board feet.
	5.	Sends proposed contracts for sales over 10 million board feet to the State Director.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Responsible Office/Official	Step	Action
State Director	6.	Approves contract by surnaming and returns contract to District Manager with instructions to proceed with sale when sale is less than 25 million board feet.
	6a.	If he thinks any revisions are necessary, returns to District Manager.
	7.	Sends proposed contracts for sales over 25 million board feet to Director (340).
Director (340)	8.	Reviews contract, makes corrections if necessary, and forwards to Director for approval.
	8a.	If major revisions in sale layout or contract preparation are necessary, or further planning and analysis are needed, returns contract to the State Director.
	9.	After approval, returns contract to State Director.
State Director	10.	Returns contract to District Manager

5424 - PREPARATION OF CONTRACT AND EXHIBITS

B. Contract Provisions. The basic contract form which has been developed for the sale of timber (Form 5430-3, Contract For The Sale of Timber - Cruise Sale) provides for the inclusion of timber reservation stipulations and special provisions. Develop the wording of timber reserve clauses and special provisions prior to the advertising of the sale. Standard provisions are not altered. (See Appendices 5 and 6.)

1. Timber Sold. Section 1 of Form 5430-3 specifies that the Government sells to the purchaser and the purchaser buys from the Government all timber in the contract area except that which is reserved to the Government under Sec. 37. Similar language is found in Section 1, Form 5430-4, Contract For The Sale of Timber - Scale Sale.

2. Time for Cutting and Removal. The maximum permissible time for the cutting and removal of timber as set forth in the regulations governing the sale of forest products is thirty (30) months. A shorter period of time may be established for cutting and removing timber, depending on the circumstances of the particular sale. The length of time allowed the purchaser for cutting and removing timber depends upon the nature of the timber sale, the volume sold, and the effective operating season. Establish the time limits in advance of the sale and specify them in the timber sale advertising. All timber sold must be cut and removed within this period.

3. Time for Removal of Personal Property. The purchaser is allowed from one to twelve months additional time for the removal of personal property. Logs are not considered personal property within the context of BLM contracts.

4. Timber Reserved From Cutting. The importance of this provision can be well understood when it is realized that the purchaser may cut and remove any and all timber on the contract area which is not otherwise reserved to the Government. Insert the correct reservation stipulation into Section 37 of Form 5430-3 or Section 36 of Form 5430-4 to adequately reserve timber from cutting and retain it as property of the Government. On the other hand, timber which has been sold and is intended to be cut should not be inadvertently reserved under Section 37 of Form 5430-3, or Section 36 of Form 5430-4. (See Appendix 5.)

5424 - PREPARATION OF CONTRACT AND EXHIBITS

5. Special Provisions. Include special provisions in Section 38 of Form 5430-3, or in Section 37 of Form 5430-4, or in Section 17 of Form 5450-1, Contract For the Cash Sale of Vegetative Resources. State Directors may develop special provisions when standard provisions are inadequate to cover the situation. (See Appendix 6.)

a. Prior Legal Review. Proposed special provisions developed by the State Director, other than those shown in Appendices 5 and 6, must be approved by the Regional or Field Solicitor before being included in a timber sale contract. Approval of special provisions may be on a case-by-case basis or for general usage.

b. Listings of Supplemental Provisions. The Director (340) publishes and maintains a list of approved timber reservation and special contract provisions.

c. Log Export Provisions. Timber sales west of the 100th meridian during calendar years 1969-71 must contain special provisions restricting the export from the United States of certain volumes or species of timber. (See Appendices 3 and 4.)

6. Equal Opportunity in Employment. Attach Form 1140-3, Equal Opportunity in Employment - Certification of Nonsegregated Facilities, to contract. (See Illustration 5.)

5424 - PREPARATION OF CONTRACT AND EXHIBITS

C. Contract Exhibits. These include basic maps, erosion control diagrams, road construction plans and specifications, etc. needed to assure compliance with contract requirements. When preparing maps, use legend symbols and wording in the Map Symbol Handbook, 9161.

1. Contract Map. Section 1 of the basic series of timber sale contract forms requires that the contract area be shown on a map marked Exhibit A. This map shows contract areas, cutting areas, reserve areas, existing improvements, proposed improvements, topographic features, and found corners. The contract area coincides with legal subdivision boundaries wherever possible. (See Illustration 2.)

a. Distribution. Attach one copy to each copy of the contract. Additional copies should be printed for use later on with contract modifications, reforestation projects, slash burning plans, logging plans, etc.

b. Color. The standard color for reserve areas is green. Clear-cut areas are white. Zip-a-Tone and cross-hatching may be used to denote special yarding areas, partial cutting areas, previous sale areas, and other special cutting areas.

2. Road Construction Plans and Specifications. If road construction or improvement is a part of a timber sale contract, attach maps and specifications marked Exhibit B, B-1, B-2, etc. These exhibits show road location, standards, surfacing, culvert quantities, clearing and culvert specifications, rock gradation, culvert gauge, plan, and profile.

3. Other Exhibits. Attach exhibits marked Exhibit C, D, etc., to the timber sale contract to insure timely and accurate completion of specific projects to be accomplished by the purchaser. Examples of projects which may require separate exhibits to the contract are:

a. Precommercial thinning stipulations
b. Fence and/or cattle guard construction specifications
c. Corner and/or bearing tree protection guidelines
d. Planting or seeding instructions
e. Slash disposal requirements
f. Smoke management plan

5424 - PREPARATION OF CONTRACT AND EXHIBITS

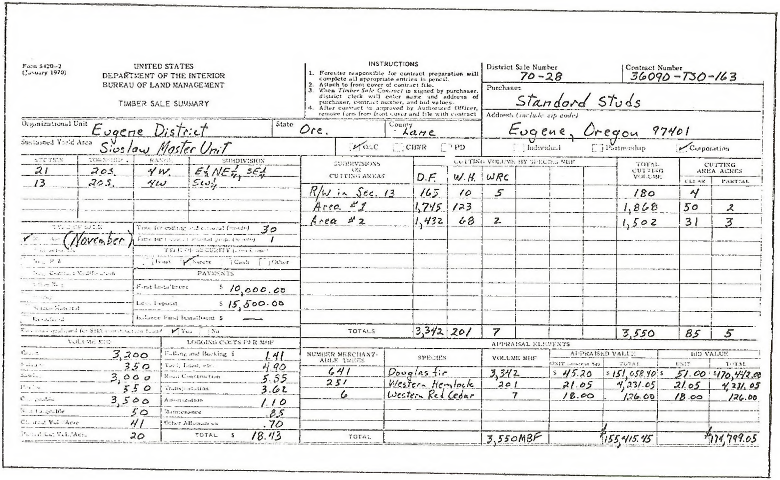
4. Miscellaneous Contract Documents. Other maps and data sheets may be included in the contract file for information or administrative purposes. These exhibits are not attached to the timber sale contract. (See .11)

.22 Scale Sales. Prepare recovery scale sales on Form 5430-4, Contract for the Sale of Timber - Scale Sale, in accordance with .21. (See Appendix 2.)

A. Scaling Standards and Requirements. Complete and attach Form 5430-5, Scaling Standards and Requirements - Exhibit B, to every sale executed on Form 5430-4. Road construction plans and specifications are designated as Exhibit C, C-1, C-2, etc.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Form 5420-2, Timber Sale Summary



Form 5420-2
(January 1970)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TIMBER SALE SUMMARY

INSTRUCTIONS

1. Forester responsible for contract preparation will complete all appropriate entries in pencil.
2. Attach to front cover of contract file.
3. When *Timber Sale Contract* is signed by purchaser, district clerk will enter name and address of purchaser, contract number, and bid values.
4. After contract is approved by Authorized Officer, remove form from front cover and file with contract

District Sale Number: 70-28

Contract Number: 36090-TS0-163

Purchaser: Standord Studs

Address (include zip code): Eugene, Oregon 97401

☐ Individual ☐ Partnership ☑ Corporation

Organizational Unit: Eugene District

State: Ore.

County: Lane

Sustained Yield Area: Siuslaw Master Unit

☑ O&C ☐ CBWR ☐ PD

SECTION	TOWNSHIP	RANGE	SUBDIVISION
21	20S.	4W.	E½NE¼, SE¼
13	20S.	4W	SW¼

SUBDIVISIONS OR CUTTING AREAS	D.F.	W.H.	WRC				TOTAL CUTTING VOLUME	CLEAR	PARTIAL
	CUTTING VOLUME BY SPECIES MBF							CUTTING AREA ACRES	
R/W in Sec. 13	165	10	5				180	4	
Area #1	1,745	123					1,868	50	2
Area #2	1,432	68	2				1,502	31	3
TOTALS	3,342	201	7				3,550	85	5

TYPE OF SALE

☑ [illegible] Adv. (November)
☐ [illegible]
☐ Neg. R/W
☐ Neg. Contract Modification
☐ Other Neg.
☐ [illegible]
☐ Salvage Material
☐ [illegible]

Time for cutting and removal (months) 30
Time for removal of personal property (months) 1

TYPE OF SECURITY

☐ Bond ☑ Surety ☐ Cash ☐ Other

PAYMENTS

First Installment $ 10,000.00
Less Deposit $ 15,500.00
Balance First Installment $ —

Was sale qualified for SBA construction loan? ☑ Yes ☐ No

VOLUME MBF		LOGGING COSTS PER MBF	
Cruise	3,200	Falling and Bucking $	1.41
Salvage	350	Yard, Load, etc.	4.90
Sawlog	3,000	Road Construction	5.55
Peeler	550	Transportation	3.62
Chippable	3,500	Amortization	1.10
Non Chargeable	50	Maintenance	.85
Cleared Vol./Acre	41	Other Allowances	.70
Partial Cut Vol./Acre	20	TOTAL $	18.43

APPRAISAL ELEMENTS

NUMBER MERCHANTABLE TREES	SPECIES	VOLUME MBF	APPRAISED VALUE UNIT (nearest 5¢)	APPRAISED VALUE TOTAL	BID VALUE UNIT	BID VALUE TOTAL
641	Douglas fir	3,342	$ 45.20	$ 151,058.40	$ 51.00	$ 170,442.00
251	Western Hemlock	201	21.05	4,231.05	21.05	4,231.05
6	Western Red Cedar	7	18.00	126.00	18.00	126.00
TOTAL		3,550MBF		$155,415.45		$174,799.05

5424 - PREPARATION OF CONTRACT AND EXHIBITS

.3 Cash Sale of Vegetative Resources. Sales of vegetative resources which are not measurable in board feet are made on Form 5450-1. (See Illustration 3.) A bond should be required if damage to the resource or land may occur as a result of the purchaser's operations. The time for Extraction, Cutting, and Removal should be less than 12 months, but under no circumstances exceed 30 months. Special stipulations may be inserted on the back of the form or added as exhibits. (See .21B5a.)

.4 Nonadvertised Sales. Nonadvertised (negotiated) sales include new contracts or modifications to existing contracts. The sale is made directly without advertising or calling for bids. The Authorized Officer takes the following steps in preparing a nonadvertised sale:

- Determines that sale is in the interest of the United States.
- Writes memorandum to case file explaining why the sale is being made on a negotiated basis rather than under competitive bidding; a statement why no bond is required if such is the case, and a justification for the appraisal if it departs from standard procedure.
- Prepares contract. (See .2) If sale is a modification of an existing contract, prepares letter modification.

.41 Negotiated Sale of Vegetative Resources (Under $100). Sales under $100 may be made on Form 5420-1, Contract for the Negotiated Cash Sale of Timber and Vegetative Resources ($100 and Under). (See Illustration 4.)

Form 9180-30, Section Diagram

EXHIBIT A

Form 9180-30
(June 1967)

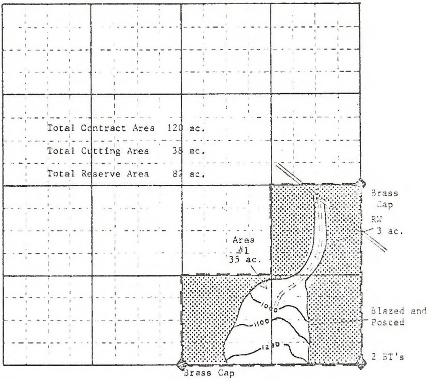
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SECTION DIAGRAM

Contract Number: 11010-TS9-65.

Map: Timber Sale

Township 1 N.	Range 5 E.	Section 31	Meridian Boise	District Boise
Mapper				Date Oct. 10, 1969


Total Contract Area 120 ac.
Total Cutting Area 38 ac.
Total Reserve Area 82 ac.
Brass Cap
RW
3 ac.
Area
#1
35 ac.
1000
1100
1200
Blazed and Posted
2 BT's
Brass Cap

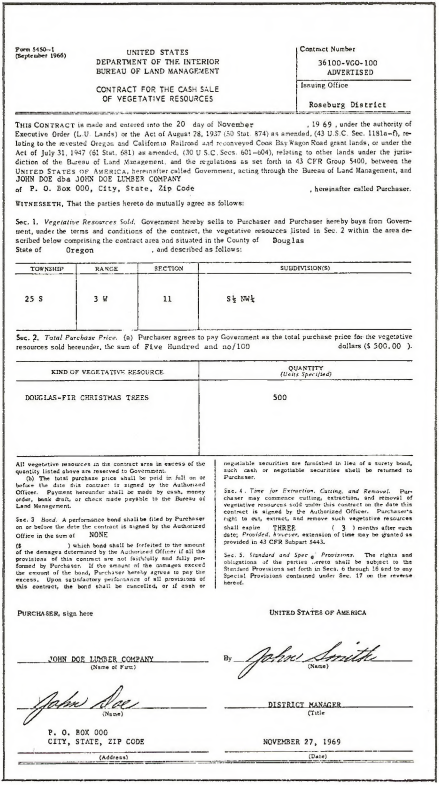
SCALE: 1" = 1,000 FT.

LEGEND

☐	Clear Cut Area	═	Existing Road
▨	Reserve Area (Green)	╌	Proposed Spur Road
☐		◈	Corners Found
☐		— —	Boundary - Contract Area
		━	Boundary - Cutting Area

GPO 935-644

Form 5450-1, Contract For the Cash Sale of Vegetative Resources



Form 5450-1
(September 1966)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONTRACT FOR THE CASH SALE
OF VEGETATIVE RESOURCES

Contract Number
36100-VGO-100
ADVERTISED

Issuing Office
Roseburg District

THIS CONTRACT is made and entered into the 20 day of November , 19 69 , under the authority of Executive Order (L.U. Lands) or the Act of August 28, 1937 (50 Stat. 874) as amended, (43 U.S.C. Sec. 1181a-f), relating to the revested Oregon and California Railroad and reconveyed Coos Bay Wagon Road grant lands, or under the Act of July 31, 1947 (61 Stat. 681) as amended, (30 U.S.C. Secs. 601-604), relating to other lands under the jurisdiction of the Bureau of Land Management, and the regulations as set forth in 43 CFR Group 5400, between the UNITED STATES OF AMERICA, hereinafter called Government, acting through the Bureau of Land Management, and JOHN DOE dba JOHN DOE LUMBER COMPANY
of P. O. Box 000, City, State, Zip Code , hereinafter called Purchaser.

WITNESSETH, That the parties hereto do mutually agree as follows:

Sec. 1. *Vegetative Resources Sold.* Government hereby sells to Purchaser and Purchaser hereby buys from Government, under the terms and conditions of the contract, the vegetative resources listed in Sec. 2 within the area described below comprising the contract area and situated in the County of Douglas
State of Oregon , and described as follows:

TOWNSHIP	RANGE	SECTION	SUBDIVISION(S)
25 S	3 W	11	S½ NW¼

Sec. 2. *Total Purchase Price.* (a) Purchaser agrees to pay Government as the total purchase price for the vegetative resources sold hereunder, the sum of Five Hundred and no/100 dollars ($ 500.00).

KIND OF VEGETATIVE RESOURCE	QUANTITY *(Units Specified)*
DOUGLAS-FIR CHRISTMAS TREES	500

All vegetative resources in the contract area in excess of the quantity listed above are reserved to Government.

(b) The total purchase price shall be paid in full on or before the date this contract is signed by the Authorized Officer. Payment hereunder shall be made by cash, money order, bank draft, or check made payable to the Bureau of Land Management.

Sec. 3 *Bond.* A performance bond shall be filed by Purchaser on or before the date the contract is signed by the Authorized Office in the sum of NONE
($) which bond shall be forfeited to the amount of the damages determined by the Authorized Officer if all the provisions of this contract are not faithfully and fully performed by Purchaser. If the amount of the damages exceed the amount of the bond, Purchaser hereby agrees to pay the excess. Upon satisfactory performance of all provisions of this contract, the bond shall be cancelled, or if cash or negotiable securities are furnished in lieu of a surety bond, such cash or negotiable securities shall be returned to Purchaser.

Sec. 4. *Time for Extraction, Cutting, and Removal.* Purchaser may commence cutting, extraction, and removal of vegetative resources sold under this contract on the date this contract is signed by the Authorized Officer. Purchaser's right to cut, extract, and remove such vegetative resources shall expire THREE (3) months after such date; *Provided, however,* extension of time may be granted as provided in 43 CFR Subpart 5443.

Sec. 5. *Standard and Special Provisions.* The rights and obligations of the parties hereto shall be subject to the Standard Provisions set forth in Secs. 6 through 16 and to any Special Provisions contained under Sec. 17 on the reverse hereof.

PURCHASER, sign here

JOHN DOE LUMBER COMPANY
(Name of Firm)

John Doe
(Name)

P. O. BOX 000
CITY, STATE, ZIP CODE
(Address)

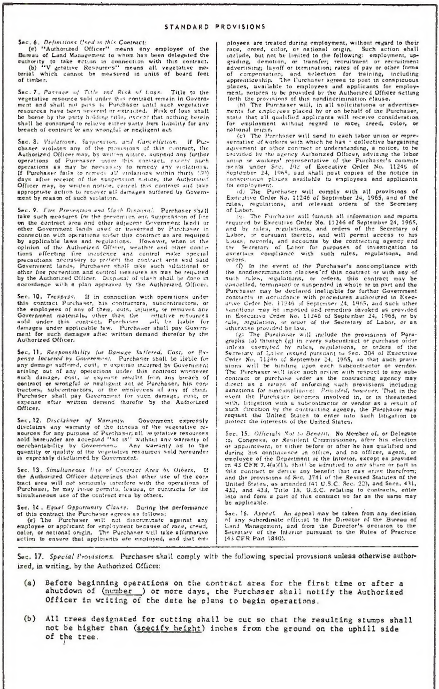
UNITED STATES OF AMERICA

By John Smith
(Name)

DISTRICT MANAGER
(Title)

NOVEMBER 27, 1969
(Date)

Form 5450-1, Contract For The Cash Sale of Vegetative Resources



STANDARD PROVISIONS

Sec. 6. *Definitions Used in this Contract:*
(a) "Authorized Officer" means any employee of the Bureau of Land Management to whom has been delegated the authority to take action in connection with this contract.
(b) "Vegetative Resources" means all vegetative material which cannot be measured in units of board feet of timber.

Sec. 7. *Passage of Title and Risk of Loss.* Title to the vegetative resource sold under this contract remain in Government and shall not pass to Purchaser until such vegetative resources have been severed or extracted. Risk of loss shall be borne by the party holding title, *except* that nothing herein shall be construed to relieve either party from liability for any breach of contract or any wrongful or negligent act.

Sec. 8. *Violations, Suspension, and Cancellation.* If Purchaser violates any of the provisions of this contract, the Authorized Officer may, by written notice, suspend any further operations of Purchaser under this contract, *except* such operations as may be necessary to remedy any violations. If Purchaser fails to remedy all violations within thirty (30) days after receipt of the suspension notice, the Authorized Officer may, by written notice, cancel this contract and take appropriate action to recover all damages suffered by Government by reason of such violation.

Sec. 9. *Fire Prevention and Slash Disposal.* Purchaser shall take such measures for the prevention and suppression of fire on the contract area and other adjacent Government lands or other Government lands used or traversed by Purchaser in connection with operations under this contract as are required by applicable laws and regulations. However, when in the opinion of the Authorized Officer, weather and other conditions effecting fire incidence and control make special precautions necessary to protect the contract area and said Government lands, Purchaser shall take such additional or other fire prevention and control measures as may be required by the Authorized Officer. Disposal of slash shall be done in accordance with a plan approved by the Authorized Officer.

Sec. 10. *Trespass.* If in connection with operations under this contract Purchaser, his contractors, subcontractors, or the employees of any of them, cuts, injures, or removes any Government materials, other than the vegetative resources sold under this contract, Purchaser will be liable for damages under applicable law. Purchaser shall pay Government for such damages after written demand therefor by the Authorized Officer.

Sec. 11. *Responsibility for Damage Suffered, Cost, or Expense Incurred by Government.* Purchaser shall be liable for any damage suffered, cost, or expense incurred by Government arising out of any operations under this contract whenever such damage, cost, or expense results from any breach of contract or wrongful or negligent act of Purchaser, his contractors, subcontractors, or the employees of any of them. Purchaser shall pay Government for such damage, cost, or expense after written demand therefor by the Authorized Officer.

Sec. 12. *Disclaimer of Warranty.* Government expressly disclaims any warranty of the fitness of the vegetative resources for any purpose of Purchaser; all vegetative resources sold hereunder are accepted "as is" without any warranty of merchantability by Government. Any warranty as to the quantity or quality of the vegetative resources sold hereunder is expressly disclaimed by Government.

Sec. 13. *Simultaneous Use of Contract Area by Others.* If the Authorized Officer determines that other use of the contract area will not seriously interfere with the operations of Purchaser, he may issue permits, leases, or contracts for the simultaneous use of the contract area by others.

Sec. 14. *Equal Opportunity Clause.* During the performance of this contract the Purchaser agrees as follows:
(a) The Purchaser will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The Purchaser will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Purchaser agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Authorized Officer setting forth the provisions of this nondiscrimination clause.
(b) The Purchaser will, in all solicitations or advertisements for employees placed by or on behalf of the Purchaser, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.
(c) The Purchaser will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency Authorized Officer, advising the labor union or workers' representative of the Purchaser's commitments under Sec. 202 of Executive Order No. 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
(d) The Purchaser will comply with all provisions of Executive Order No. 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
(e) The Purchaser will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
(f) In the event of the Purchaser's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be cancelled, terminated or suspended in whole or in part and the Purchaser may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
(g) The Purchaser will include the provisions of Paragraphs (a) through (g) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Sec. 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Purchaser will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions including sanctions for noncompliance: *Provided, however,* That in the event the Purchaser becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the Purchaser may request the United States to enter into such litigation to protect the interests of the United States.

Sec. 15. *Officials Not to Benefit.* No Member of, or Delegate to, Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this contract or derive any benefit that may arise therefrom; and the provisions of Sec. 3741 of the Revised Statutes of the United States, as amended (41 U.S.C. Sec. 22), and Secs. 431, 432, and 433, Title 18, U.S.C. relating to contracts, enter into and form a part of this contract so far as the same may be applicable.

Sec. 16. *Appeal.* An appeal may be taken from any decision of any subordinate official to the Director of the Bureau of Land Management, and from the Director's decision to the Secretary of the Interior pursuant to the Rules of Practice (43 CFR Part 1840).

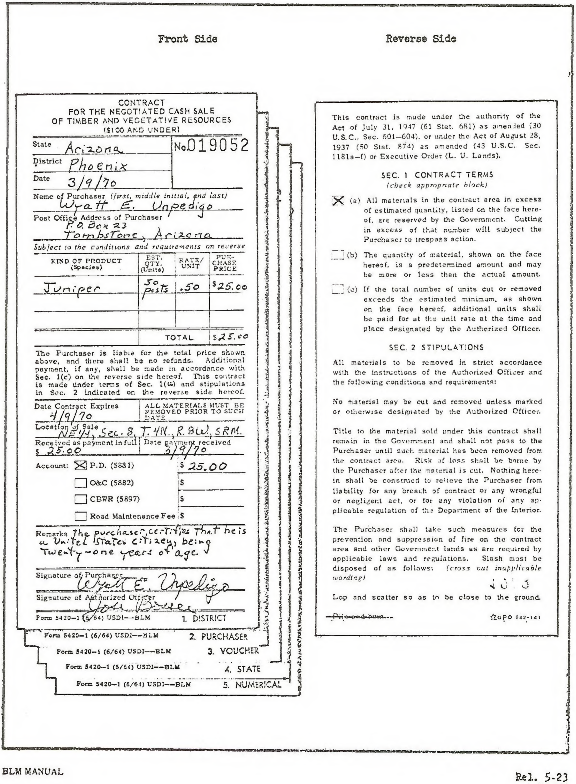
Sec. 17. *Special Provisions.* Purchaser shall comply with the following special provisions unless otherwise authorized, in writing, by the Authorized Officer:

(a) Before beginning operations on the contract area for the first time or after a shutdown of (number) or more days, the Purchaser shall notify the Authorized Officer in writing of the date he plans to begin operations.

(b) All trees designated for cutting shall be cut so that the resulting stumps shall not be higher than (specify height) inches from the ground on the uphill side of the tree.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Form 5420-1, Contract For The Negotiated Cash Sale of Timber and Vegetative Resources ($100 and Under)



Front Side

Reverse Side

CONTRACT
FOR THE NEGOTIATED CASH SALE
OF TIMBER AND VEGETATIVE RESOURCES
($100 AND UNDER)

No 019052

State Arizona

District Phoenix

Date 3/9/70

Name of Purchaser *(first, middle initial, and last)* Wyatt E. Unpedigo

Post Office Address of Purchaser P. O. Box 23
Tombstone, Arizona

Subject to the conditions and requirements on reverse

KIND OF PRODUCT (Species)	EST. QTY. (Units)	RATE/ UNIT	PUR-CHASE PRICE
Juniper	50 posts	.50	$25.00
		TOTAL	$25.00

The Purchaser is liable for the total price shown above, and there shall be no refunds. Additional payment, if any, shall be made in accordance with Sec. 1(c) on the reverse side hereof. This contract is made under terms of Sec. 1(a) and stipulations in Sec. 2 indicated on the reverse side hereof.

Date Contract Expires 4/9/70

ALL MATERIALS MUST BE REMOVED PRIOR TO SUCH DATE

Location of Sale NE1/4, Sec. 8, T. 4N., R. 8W., SRM.

Received as payment in full $ 25.00

Date payment received 3/9/70

Account: ☒ P.D. (5881) $ 25.00
☐ O&C (5882) $
☐ CBWR (5897) $
☐ Road Maintenance Fee $

Remarks The purchaser, certifies that he is a United States citizen, being Twenty-one years of age.

Signature of Purchaser Wyatt E. Unpedigo

Signature of Authorized Officer John Bisse

Form 5420-1 (6/64) USDI--BLM 1. DISTRICT

Form 5420-1 (6/64) USDI--BLM 2. PURCHASER

Form 5420-1 (6/64) USDI--BLM 3. VOUCHER

Form 5420-1 (5/64) USDI--BLM 4. STATE

Form 5420-1 (6/64) USDI--BLM 5. NUMERICAL

This contract is made under the authority of the Act of July 31, 1947 (61 Stat. 681) as amended (30 U.S.C., Sec. 601–604), or under the Act of August 28, 1937 (50 Stat. 874) as amended (43 U.S.C. Sec. 1181a–f) or Executive Order (L. U. Lands).

SEC. 1 CONTRACT TERMS
(check appropriate block)

☒ (a) All materials in the contract area in excess of estimated quantity, listed on the face hereof, are reserved by the Government. Cutting in excess of that number will subject the Purchaser to trespass action.

☐ (b) The quantity of material, shown on the face hereof, is a predetermined amount and may be more or less than the actual amount.

☐ (c) If the total number of units cut or removed exceeds the estimated minimum, as shown on the face hereof, additional units shall be paid for at the unit rate at the time and place designated by the Authorized Officer.

SEC. 2 STIPULATIONS

All materials to be removed in strict accordance with the instructions of the Authorized Officer and the following conditions and requirements:

No material may be cut and removed unless marked or otherwise designated by the Authorized Officer.

Title to the material sold under this contract shall remain in the Government and shall not pass to the Purchaser until such material has been removed from the contract area. Risk of loss shall be borne by the Purchaser after the material is cut. Nothing herein shall be construed to relieve the Purchaser from liability for any breach of contract or any wrongful or negligent act, or for any violation of any applicable regulation of the Department of the Interior.

The Purchaser shall take such measures for the prevention and suppression of fire on the contract area and other Government lands as are required by applicable laws and regulations. Slash must be disposed of as follows: *(cross out inapplicable wording)*

Lop and scatter so as to be close to the ground.

~~Pile and burn.~~

GPO 842-141

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Form 1140-3, Equal Opportunity in Employment -
Certification of Nonsegregated Facilities

Form 1140-3
(May 1968)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

EQUAL OPPORTUNITY IN EMPLOYMENT
CERTIFICATION OF NONSEGREGATED FACILITIES

Bid, offer or contract number or other identification:
36090-TSO-163

By the submission of this bid or offer and/or by entering into this contract, the bidder, offeror, lessee, subcontractor, or applicant certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means, but is not limited to, any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

In accordance with 41 CFR 60, as amended May 19, 1967, and Executive Order No. 11246 of September 24, 1965, this certification is applicable to all bids, offers, contracts and subcontracts as well as agreements with applicants who are themselves performing federally assisted contracts, which may exceed $10,000 and are not exempt from the provisions of the Equal Opportunity clause of the Order.

GPO 842-586

Encl. 1

LOG EXPORT SPECIAL STIPULATION LE-1

(For use with sales of $2000 or more appraised value, but less than 2.0 MMBF* to be offered for sale prior to adoption of rules on non-substitution. When such rules have been adopted, this provision will have to be amended. *For use in all contracts of $2000 or more appraised value - outside of western Oregon Districts.)

All timber sold to the Purchaser under the terms of this contract is restricted from export from the United States in the form of unprocessed timber. For the purpose of this contract, unprocessed timber is defined as (1) any logs, such as sawlogs, peeler logs, and pulp logs; (2) cants or squares to be subsequently remanufactured exceeding a nominal eight (8) inches in thickness; or (3) split or round bolts or other roundwood not processed to standards and specifications suitable for end product use. Thus, timber manufactured into the following will be considered processed: (1) lumber and construction timbers, regardless of size, manufactured to standards and specifications suitable for end product uses; (2) chips, pulp and pulp products; (3) green or dry veneer and plywood; (4) poles and piling cut or treated for use as such; (5) cants, squares, and lumber cut for remanufacture of a nominal eight (8) inches in thickness or less.

In the event the Purchaser elects to sell any or all of the timber sold under this contract in the form of unprocessed timber, the Purchaser shall require each party buying, exchanging, or receiving such timber to execute a "Certificate as to Domestic Processing of Timber." The original of such certification shall be filed with the Authorized Officer.

Prior to the termination of this contract, the Purchaser shall submit to the Authorized Officer a "Certificate of Disposition of Timber Sale Volume" which shall be executed by the Purchaser. In addition, the Purchaser is required under the terms of this contract to retain for a three-year period from the date of termination of the contract the records of all sales or transfer of logs involving timber from the sale for inspection and use of the Bureau of Land Management.

Unless otherwise authorized in writing by the Authorized Officer, the Purchaser shall, prior to the removal of timber from the contract area, brand with the Purchaser's registered log brand at least one end of each log bolt or other roundwood and indentify each of these by painting with highway yellow paint.

In the event of the Purchaser's noncompliance with this subsection of the contract, the Authorized Officer may take appropriate action as set forth in Section 10 of this contract. In addition, the Purchaser may be declared ineligible to receive future awards of Government timber for a period of one year.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

LOG EXPORT SPECIAL STIPULATION LE-2

(For use with sales 2.0 MMBF or larger* offered for sale prior to adoption of rules on non-sbustitution and prior to determination of surplus quantities of Port Orford cedar. When such rules and determination have been made, this provision will have to be amended. *For use only in western Oregon districts, however).

Except _________ M board feet (Scribner Decimal C 16 Foot Log Rule) of any species, all other timber sold the Purchaser under the terms of this contract is restricted from export from the United States in the form of unprocessed timber. For the purpose of this contract, unprocessed timber is defined as (1) any logs, such as sawlogs, peeler logs and pulp logs; (2) cants or squares to be subsequently remanufactured exceeding a nominal eight (8) inches in thickness; or (3) split or round bolts or other roundwood not processed to standards and specifications suitable for end product use. Thus, timber manufactured into the following will be considered processed: (1) lumber and construction timbers, regardless of size, manufactured to standards and specifications suitable for end product uses; (2) chips, pulp and pulp products; (3) green or dry veneer and plywood; (4) poles and piling cut or treated for use as such; (5) cants, squares and lumber cut for remanufacture of a nominal eight (8) inches in thickness or less.

In the event the Purchaser elects to sell any or all of the non-excepted timber sold under this contract in the form of unprocessed timber, the Purchaser shall require each party buying, exchanging or receiving such timber to execute a "Certificate as to Domestic Processing of Timber." The original of such certification shall be filed with the Authorized Officer.

In the event the Purchaser elects to export or to sell for export purposes any or all of the timber exempted from the restrictions on export, he shall file with the Authorized Officer a "Notice of Removal of Exempted Timber for Export Purposes" at least ten days prior to the removal of such exempted timber from the contract area.

Prior to the termination of this contact, the Purchaser shall submit to the Authorized Officer a "Certificate of Disposition of Timber Sale Volume" which shall be executed by the Purchaser. In addition, the Purchaser is required under the terms of this contract to retain for a three-year period from the date of termination of the contract, the records of all sales or transfer of logs involving timber from the sale for the inspection and use of the Bureau of Land Management.

Unless otherwise authorized in writing by the Authorized Officer, the Purchaser shall comply with the following requirements prior to the removal of timber from the contract area.

(1) Unprocessed timber restricted from export. Brand with the Purchaser's registered log brand at least one end of each log, bolt or other roundwood and identify each of these by painting with highway yellow paint.

(2) Timber excepted from export restrictions. Brand with Purchaser's registered log brand, different from that used on restricted timber, at least one end of each log, bolt or other roundwood and segregate excepted logs restricted from export at locations on or adjacent to the contract area; furthermore, such excepted logs shall not be painted with highway yellow paint.

In the event of the Purchaser's non-compliance with the subsection of the contract, the Authorized Officer may take appropriate action as set forth in Section 10 of this contract. In addition, the Purchaser may be declared ineligible to receive future awards of Government timber for a period of one year.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Timber Reservation Provisions

The timber reserve provisions presented in this illustration have been developed and approved for use with Contract Forms 5430-3 (July 1966) and 5430-4 (July 1966). The provisions relate to area reservations (AR-) and to individual tree reservations (IR-). The provisions are to be used as written with insertion of appropriate language within the parenthetical enclosures. Situations which require timber reserve clauses other than those presented herein must be approved by the State Director prior to use.

PROVISION	INSTRUCTIONS	EXAMPLE
AR-1 All timber on the reserve area(s) shown on Exhibit A and all (describe how boundary trees are marked) trees which are on or mark the boundaries of the reserve area(s).	Use AR-1 to reserve from cutting all timber on a designated area or areas.	All timber on the reserve area shown on Exhibit A and all blazed, painted or posted trees which are on or mark the boundaries of the reserve area.
AR-2 All timber on the reserve area(s) shown on Exhibit A and all (blazed, painted or posted) trees which are on or mark the boundaries of the reserve area(s), except approximately (specify number of trees by kind or species) marked for cutting with (describe how trees are marked) in (give location) shown on Exhibit A.	Use AR-2 to permit the cutting of marked trees in an area where trees are otherwise reserved from cutting.	All timber on the reserve areas shown on Exhibit A and all blazed, painted or posted trees which are on or mark the boundaries of the reserve areas, except approximately one hundred twenty-four (124) Douglas-fir trees marked for cutting with red paint in the reserve areas shown on Exhibit A.
IR-1 Approximately (specify number of trees by species or kind) trees marked with (describe how trees are marked) in (give location) as on Exhibit A.	IR-1 is used when the trees to be reserved from cutting are individually marked, as in the case of seed trees. Unmarked trees may be cut. The general area to which the reservation applies must be shown on the contract map and be identifiable in the field.	Approximately one hundred fifty (150) Douglas-fir trees and fifty (50) western redcedar trees marked with white paint and aluminum tags in the partial cut area shown on Exhibit A.
IR-2 All timber except approximately (specify number by kind or species) trees marked for cutting with (describe how trees are marked) in (give location) shown on Exhibit A.	IR-2 is used to reserve all unmarked trees on a cutting area. Only marked trees may be cut. The general area to which the reservation applies must be shown on the contract map and be identifiable in the field.	All timber except approximately one hundred fifty (150) Douglas-fir, forty-seven (47) western hemlock and thirty-seven (37) western redcedar marked for cutting with red paint in partial cut area shown on Exhibit A.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Timber Reservation Provisions

PROVISION	INSTRUCTIONS	EXAMPLE
IR-3 All (identify species) trees which are smaller than (specify diameter) inches D.B.H.O.B. in (give location) shown on Exhibit A.	IR-3 is a reservation based upon diameter limit. All trees, by species if desired which measure less than that specified in the provision are reserved to the Government. Trees exceeding the minimum diameter may be cut. The general area to which the provision applies must be shown on the contract map and be identifiable in the field.	All lodgepole pine trees which are smaller than eleven (11) inches D.B.H.O.B. in the cutting area shown on Exhibit A.
IR-4 All (identify species) trees which are smaller than (specify diameter) inches D.B.H.O.B., except approximately (specify number) trees thereof marked for cutting with (describe how trees are marked) in (give location) shown on Exhibit A.	IR-4 is a reservation based upon diameter limits similar to IR-3. However, IR-4 does permit the cutting of trees otherwise reserved when such trees have been marked for cutting. The general area to which this provision applies must be shown on the contract map and be identifiable in the field.	All lodgepole pine trees which are smaller than eleven (11) inches D.B.H.O.B., except approximately thirty-four (34) trees thereof marked for cutting with red paint in the cutting area shown on Exhibit A.
IR-5 All young growth less than (specify diameter) inches D.B.H.O.B. not damaged in the normal course of logging in (give location) shown on Exhibit A.	Use IR-5 to reserve and protect reproduction present on the cutting area. This provision may be of particular importance in two and three-storied stands. The general area to which this provision applies must be shown on the contract map and be identifiable in the field.	All young growth timber less than eight (8) inches D.B.H.O.B. in the clear cut area shown on Exhibit A.
IR-6 All (identify species) trees in (give location) shown on Exhibit A.	Use IR-6 to reserve all trees of one or more species on a given area while permitting the harvest of all trees of unnamed species. The general area to which this provision applies must be shown on the contract map and be identifiable in the field.	All ponderosa pine and sugar pine trees in the cutting area shown on Exhibit A.

GPO [illegible]

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Timber Reservation Provisions

PROVISION	INSTRUCTIONS	EXAMPLE
IR-7 All (identify species) trees except approximately (specify number by species) trees marked for cutting with (describe how trees are marked) in (give location) shown on Exhibit A.	IR-7 is used to reserve all trees of one or more species except for certain trees of the named species which are marked for cutting. All trees of unnamed species may be cut. The general area to which this provision applies must be shown on the contract map and be idenfifiable in the field.	All ponderosa pine and sugar pine trees except approximately twenty-four (24) ponderosa pine trees and eighteen (18) sugar pine trees marked for cutting with blue paint in the partial cut area shown on Exhibit A.
IR-8 All timber except (identify species) trees in (give location) shown on Exhibit A.	IR-8 is used to reserve all species of timber found on the cutting area except the named species. The purchaser may cut only trees of the named species. The general area to which this provision applies must be shown on the contract map and be identifiable in the field.	All timber except incense cedar trees in the partial cut area shown on Exhibit A.
IR-9 All timber except (identify species) trees and except approximately (number and species) trees marked for cutting with (describe mark) in (give location) shown on Exhibit A.	IR-9 is used to reserve all species of timber found on the cutting area except for the species named and except for certain other trees which have been marked for cutting. The general area to which the provision applies must be shown on the contract map and be identifiable in the field.	All timber except incense cedar trees and except approximately forty-four (44) ponderosa pine trees marked for cutting with red paint in the partial cut area shown on Exhibit A.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Timber Reservation Provisions

PROVISION	INSTRUCTIONS	EXAMPLE
AR-3 All timber except logs which were severed from the stump and located within ________ of the centerline of Road No. ________ as shown on Exhibit A prior to the date this contract was entered into.	For use in cull log sales only. For use when cull logging area is within specified distance from centerline of an existing road. Exhibit A shows "Reserve Area" and "Approximate area in which logs were designated for cutting in the Reserve Area".	All timber except logs which were severed from the stump and located with 200 feet of the centerline of Road No. 22-4-17.1 as shown on Exhibit A prior to the date this contract was entered into.
AR-4 All timber shown on the Reserve Area on Exhibit A and all blazed or posted trees which are on or mark the boundary of the Reserve Area. All timber except logs which were severed from the stump prior to the date this contract was entered into in the Special Cutting Area shown on Exhibit A.	For use in cull log sales only. For use when cull logging area boundary is defined from reserve area by blazing or posting. Exhibit A shows "Reserve Area" and "Special Cutting Area."	
AR-5 All timber shown on the Reserve Area and all timber except logs which were severed from the stump prior to the date this contract was entered into in the Special Cutting Area shown on Exhibit A."	For use in cull log sales only. For use when cull logging area is totally within a previous clear cut area and the boundary between the cull logging area and the reserve area is marked by colored flagging. Exhibit A shows "Reserve Area" and "Special Cutting Area." The color of the flagging boundary is described and shown on Exhibit A.	

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Timber Reservation Provisions

Provisions	Instructions	Example
AR-6 All timber on the reserve area (s) shown on Exhibit A and all (describe how boundary trees are marked) trees which are on or mark the boundaries of reserve area (s); provided, however, that all dead trees over (specify number of feet) feet in height and over (specify number of inches) in diameter at a point four and one-half (4½) feet above the ground (both height and diameter measurements taken on the uphill side of the tree), located (give location) shall be felled by the Purchaser. If cutting is commenced in the winter season all such trees shall be felled prior to (give date); otherwise all such trees shall be felled prior to cutting green timber. The Purchaser shall not remove such trees without the written consent of the Authorized Officer and full payment to the Government for the value of such trees.	Use in situations where it may be silviculturally undesirable to remove snags felled in corridors, or to cover situations where the salvage of so-called sound snags may be questionable.	All timber on the reserve areas shown on Exhibit A and all blazed or posted trees which are on or mark the boundaries of reserve areas; provided, however, that all dead trees fifteen (15) feet in height and over twelve (12) inches in diameter at a point four and one-half (4½) feet above the ground as measured on the uphill side of the tree located in the snag-free corridor as shown on Exhibit A shall be felled by the Purchaser. If cutting is commenced in the winter season all such trees shall be felled prior to April 1; otherwise, all such trees shall be felled prior to cutting green timber. The Purchaser shall not remove such trees without the written consent of the Authorized Officer and full payment to the Government for the value of such trees.

Special Provisions

The special provisions presented in this illustration have been developed and approved for use with contract forms 5430-3 (July 1966) and 5430-4 (July 1966).

The provisions are set forth in the following basic categories:

L - Provisions pertaining to logging

RC - Provisions pertaining to construction

E - Provisions pertaining to environmental protection

M - Provisions pertaining to miscellaneous items

F - Provisions pertaining to fire protection

The provisions are to be used as written. Certain provisions require insertion of words or phrases appropriate to the situation. Users have certain latitude for choice of appropriate wording within the parenthetic enclosures provided that such choice of wording does not alter or amend the intent of the basic provision.

Situations which require special provisions other than presented herein must be approved by the State Director and Regional or Field Solicitor prior to use. (See .21B5a.)

Special provisions for environmental protection and fire protection for Bureau-wide use are being developed. Pending approval of these two important special stipulation sections, State Directors will develop the necessary environmental protection and fire protection stipulations.

PROVISIONS	INSTRUCTIONS	EXAMPLE
L-1 Before beginning operations on the contract area for the first time or after a shutdown of (number) or more days, the Purchaser shall notify the Authorized Officer in writing of the date he plans to begin operations. He shall also notify the Authorized Officer in writing if he intends to cease operations for any period of (number) or more days.	Use L-1 when it is desirable to require Purchaser to advise the Authorized Officer of the commencement and cessation of operations on the contract area.	
L-2 Clear cutting (Partial Cutting) where designated shall be (enter completion date or other completion instructions).	Use L-2 to require completion of timber cutting and/or timber harvesting by a specific date for a specific purpose. The use of this provision should not contradict the cutting and removal rights expressed in Section 4 of the contract.	Clear cutting, where designated, shall be completed before March 15, 1969. Partial cutting, where designated, shall be continued without interruption until completed.
L-3 All trees designated for cutting shall be cut so that the resulting stumps shall not be higher than (specify height) inches measured from the ground on the uphill side of the trees.	Use L-3 to regulate stump heights of trees designated for cutting. This provision is of particular importance on scale sales.	All trees designated for cutting shall be cut so that the resulting stumps shall not be higher than twelve (12) inches measured from the ground on the uphill side of the tree.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
L-4 All trees (specify minimum diameter) inches or larger D.B.H.O.B. and not reserved shall be felled in (give location) shown on Exhibit A.	Use L-4 to require the felling of all trees sold or designated for cutting under the contract. This provision is generally associated with clear cutting operations where it is desirable to fall all trees in the area.	All trees eight (8) inches or larger D.B.H.O.B. and not reserved shall be felled in the clear cut area shown on Exhibit A.
L-5 (All snags, culls and marginal trees)(All trees eight (8) inches D.B.H.O.B.) designated for cutting shall be felled concurrently with all other trees designated for cutting in (give location).	Use L-5 to require purchaser to fell trees on a concurrent basis. This provision is particularly applicable where it is desirable to fall snags and culls at the same time as other trees.	All snags, culls and marginal trees designated for cutting shall be felled concurrently with all other trees designated for cutting in the selective cutting area shown on Exhibit A. All trees eight (8) inches or larger D.B.H.O.B. designated for cutting shall be felled concurrently with all other trees designated for cutting in the same yarding area.
L-6 In the (give location) shown on Exhibit A, all trees designated for cutting shall be felled and cut into log lengths not to exceed (specify maximum log length) feet before being yarded.	Use L-6 to regulate log length in thinning sales where skidding of long logs or by tree lengths may result in excessive damage to the individual stand.	In the entire contract area shown on Exhibit A, all trees designated for cutting shall be felled and cut into log lengths not to exceed thirty-three (33) feet before being yarded.
L-7 In the (give location) shown on Exhibit A, yarding shall be done (describe equipment requirements or limitations).	Use L-7 to regulate the type of logging equipment to be used on an area.	In the clearcut area shown on Exhibit A, yarding shall be done with high lead type equipment. In the entire contract area shown on Exhibit A, yarding shall be done with crawler type equipment without bulldozers, angle dozers or arches. In the selective cut area shown on Exhibit A, yarding shall be done with horses or with a tractor of no more than fifty-five (55) drawbar for horsepower.

GPO 856-051

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
L-8 In the (give location) shown on Exhibit A, all logs more than (specify minimum diameter) inches in scaling diameter and longer than (specify minimum length) feet in length shall be decked or windrowed at the location (describe location) except logs sold and removed from the contract area.	Use L-8 to require the decking of unmerchantable material on the cutting area. This provision has particular application to areas where it is desirable to prepare the area for reforestation.	In the clearcut area shown on Exhibit A, all logs more than twenty (20) inches in scaling diameter and longer than eight (8) feet in length shall be decked or windrowed at the location designated by the Authorized Officer except logs sold and removed from the contract area.
L-9 No yarding or loading in or through the (describe location) shown in Exhibit A.	Use L-9 in instances where it is essential to prohibit yarding or loading in or through a particular area within the contract area in order to protect specific values.	No yarding or loading is permitted in or through the reserve area shown in Exhibit A.
L-10 Yarding across (identify river or stream) shall be limited to not more than (specify number) crossings. Crossing structures shall comply with plans and specifications shown on Exhibit (identify exhibit).	Use L-10 to provide protection to streams and water courses by regulation of the number and type of crossings permitted.	Yarding across Bear Creek shall be limited to not more than two (2) crossings. Crossing structures shall comply with the plans and specifications shown on Exhibit C.
L-11 No landing shall be located within (specify distance) feet of (describe location or feature) shown on Exhibit A.	Use L-11 to protect areas, roads, streams, etc., from encroachment of landings.	No landing shall be located within two hundred (200) feet of County Road #20 shown on Exhibit A.
L-12 (Specify landings) shall be placed at the approximate locations(s) shown on Exhibit A.	Use L-12 when it is essential to restrict landings to specific locations which have been designated in advance of sale.	All landings in the partial cut area shall be placed at the approximate locations shown on Exhibit A.
L-13 Prior to the commencement of operations, the Purchaser shall obtain from the Authorized Officer written approval of a written logging plan. All logging shall be done in accordance with such plan.	Use L-13 when it is desirable to regulate logging through the medium of a written logging plan prepared by the Purchaser and approved by the Authorized Officer.	

GPO 858-051

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
L-14 There are (specify number) trees marked (describe how trees are marked) located approximately as shown on Exhibit A, that will be used as a check cruise plot. The Purchaser shall fell and buck these trees, separate the bucked logs for examination and leave such logs in place. The Purchaser shall notify the Authorized Officer when the bucking is completed. Removal of logs is prohibited until written permission is granted by the Authorized Officer.	Use L-14 when it is desirable to establish check cruise plots on timber sale areas. Such plots furnish the appraiser an excellent opportunity to check the accuracy of his cruising.	There are fifteen (15) trees marked with red paint and numbered consecutively from one (1) to fifteen (15) located approximately as shown on Exhibit A, that will be used as a check cruise plot. The Purchaser shall fell and buck these trees, separate the bucked logs for examination and leave such logs in place. The Purchaser shall notify the Authorized Officer when the bucking is completed. Removal of logs is prohibited until written permission is granted by the Authorized Officer.
RC-1 The Purchaser shall (describe construction required) to the satisfaction of the Authorized Officer in a good and workmanlike manner, in conformity with law, and in accordance with the plans and specifications listed in Exhibit (identify exhibit) and the location shown on Exhibit (identify exhibit). (RC-1a, RC-1b, RC-1c or RC-1d must be added to RC-1 to complete the provision.)	Use RC-1 to require the construction or improvement of such items as roads, bridges, cattleguards, fences, etc. RC-1 may not stand alone but must be supplemented by the addition of a statement prescribing when and under what conditions such construction must be completed. See RC-1a, RC-1b, RC-1c and RC-1d.	See RC-1a, RC-1b, RC-1c or RC-1d for examples of RC-1 in use.
RC-1a Prior to the removal of any timber (list exceptions, if any) from (describe cutting area), the Purchaser shall complete road construction from (describe limits) shown on Exhibit (identify exhibit).	Add RC-1a to RC-1 when removal of timber purchased is conditioned upon satisfactory completion of road construction.	The Purchaser shall construct the Bear Creek Road to the satisfaction of the Authorized Officer in a good and workmanlike manner, in conformity with law, and in accordance with the plans and specifications listed on Exhibit B and the location shown on Exhibit C. Prior to the removal of any timber, except right of way timber from cutting area #1, the Purchaser shall complete road construction for Station 0+00 to Station 50+00 shown on Exhibit C.

GPO 858-051

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-1b Road Construction (list exceptions, if any) shall be completed to each (describe area or location) prior to removal of any timber (list exceptions, if any) from such area. All road construction shall be completed prior to removal of any timber except right of way timber from (describe area or location) .	Add RC-1b to RC-1 to tie timber removal to completion of road construction on a segment basis. The purpose of the sentence enclosed in brackets is to insure completion of the road prior to removal of all timber. It may be omitted when there are no exceptions to road construction listed in the first sentence.	The Purchaser shall construct the Bear Creek Road to the satisfaction of the Authorized Officer in a good and workmanlike manner, in conformity with law and in accordance with the plans and specifications listed on Exhibit C and the location as approximately shown on Exhibit C. Road construction, except surfacing, shall be completed to each clearcut area prior to removal of any timber, except right of way timber, from such areas. All road construction shall be completed prior to removal of any timber except right of way timber from clearcut area #6.
RC-1c The (describe requirement) shall be completed (specify when completion is required).	Add RC-1c to RC-1 when it is desirable to require completion of the work by a specified date.	The Purchaser shall construct the Bear Creek Road to the satisfaction of the Authorized Officer in a good and workmanlike manner, in conformity with law, and in accordance with the plans and specifications listed on Exhibit C and the location as approximately shown on Exhibit D. The required road construction shall be completed within one (1) year after the approval date of this contract.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-1d The Purchaser shall not commence work until receipt of written notice to do so from the Authorized Officer. Work shall be commenced no later than (specify number of days) days after such notice, and shall be completed (specify when completion is required).	Add RC-1d to RC-1 when it is necessary and desirable for the Authorized Officer to regulate the construction period.	The Purchaser shall construct the Mule Creek Bridge to the satisfaction of the Authorized Officer in a good and workmanlike manner, in conformity with law, and in accordance with the plans and specifications listed on Exhibit C and the locations as approximately shown on Exhibit D. The purchaser shall not commence work until receipt of written notice to do so from the Authorized Officer. Work shall be commenced no later than thirty (30) days after such notice and shall be completed within six (6) months after such notice.
RC-2 The Purchaser is authorized to use the (describe or name road to which this provision applies) which is under the jurisdiction of the Bureau of Land Management from (describe terminal road by legal description) for the removal of Government timber sold under the terms of this contract: (RC-2a, RC-2c or RC-2d must be added to RC-2 to complete the provision).	Use RC-2 to authorize use of roads off the contract area owned or controlled by the Bureau of Land Management. RC-2 may not stand alone but must be supplemented by the addition of RC-2a, RC-2c, or RC-2d which set forth the road maintenance requirements for such roads.	See RC-2a, RC-2c and RC-2d for examples of RC-2 in use.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-2a Provided, that at all times during the period of his operations on the contract area, and upon completion of said operations, the Purchaser shall be liable for maintenance and repair of such roads resulting from wear or damage, except damage caused by major catastrophies or disasters resulting from Acts of God, flood, fire, war or riots, or wear or damage caused by third party users.	Add RC-2a to RC-2 when the Purchaser will be required to maintain roads the use of which is authorized by RC-2.	The Purchaser is authorized to use the Kelsey-Mule Creek Access Road, which is under the jurisdiction of the Bureau of Land Management from SW¼SW¼, Sec. 14, T. 32 S., R. 9 W., W.M. to SE¼NE¼, Sec. 13, T. 32 S., R. 8 W., W.M. for the removal of Government timber sold under the terms of this contract; provided, that at all times during the period of his operations on the contract area, and upon completion of said operations, the Purchaser shall be liable for maintenance and repair of such roads resulting from wear or damage, except damage caused by major catastrophies or disasters resulting from Acts of God, flood, fire, war or riots, or wear or damage caused by third party users.
RC-2b With the prior written approval of the Authorized Officer, the Purchaser may arrange for cooperative maintenance with other users of said road(s) described in Sec. (identify section) of this contract provided that such cooperative arrangement shall not relieve the Purchaser of his liability for the maintenance and repair of such roads resulting from wear or damage, except damage caused by major catastrophies or disasters, resulting from Acts of God, flood, fire, war or riots, or wear or damage caused by third party users.	Use RC-2b in addition to the combination of RC-2 and RC-2a when it is anticipated that roads authorized for use will be used by more than one purchaser during the life of the contract.	With the prior written approval of the Authorized Officer, the Purchaser may arrange for cooperative maintenance with other users of roads described in Sec. 38(c) of this contract; provided, that such cooperative arrangement shall not relieve the Purchaser of his liability for the maintenance and repair of such roads resulting from wear or damage except damage caused by major catastrophies or disasters resulting from Acts of God, flood, fire, war or riots, or wear or damage caused by third party users.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-2c Provided, that the Purchaser shall pay the Government a road maintenance fee of (express total fee due in both words and figures) for the transportation of any timber included in this contract price over said road. The above maintenance fee is for the use of (number) ( ) miles of road or less. Unless the total maintenance fee is paid prior to commencement of operations on the contract area, payments shall be made in installments of not less than (specify minimum installment using both words and figures) payable in the same manner as and together with installment payments required by Sec. 2(b)(2) (or 3(a)(2) of Form 5430-4) of this contract.	Add RC-2c to RC-2 when the Purchaser is required to pay a road maintenance fee to the Government for roads the use of which is authorized by RC-2. RC-2c is used when no alternate routes of access are available. This provision applies to lump sum sales only.	The Purchaser is authorized to use the Kelsey-Mule Creek Access Road, which is under the jurisdiction of the Bureau of Land Management from the SW¼SW¼, Sec. 14, T. 32 S., R. 9 W., W.M., to SE¼NE¼, Sec. 13, T. 32 S., R. 8 W., W.M. for the removal of Government timber sold under the terms of this contract; provided, that the Purchaser shall pay a road maintenance fee of Four Thousand Five Hundred and no/100 Dollars ($4,500.00) for the transportation of timber included in the contract area over such road. Unless the total maintenance fee is paid prior to commencement of operations on the contract area, payment shall be made in installments of not less than Five Hundred and no/100 Dollars ($500.00) payable in the same manner as and together with installment payments required by Sec. 3(b)(2) of this contract

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-2d Provided that the Purchaser shall pay the Government a road maintenance fee of (specify amount) per thousand board feet per mile for the use of said roads. For administrative purposes the total maintenance fee due shall be based upon the estimated volume set forth in Sec. 3(a) of this contract and mileage of roads used as determined by the Authorized Officer. In the event logs are hauled over more than one route, the estimated volume set forth in Sec. 3(a) shall be proportioned on the basis of actual volume removed. Prior to the use of such roads, the Purchaser shall give written notice to the Authorized Officer of the roads he intends to use in the removal of the timber purchased under the contract, together with an estimate of the volume to be hauled over such roads. If the total road maintenance fee does not exceed Five Hundred Dollars ($500.00), the Purchaser shall pay such fee in full prior to use of such roads. If the total road maintenance fee exceeds Five Hundred Dollars ($500.00), the Authorized Officer shall establish an installment schedule of payments of the maintenance fees.	Add RC-2d to RC-2 when the Purchaser is required to pay a road maintenance fee to the Government for roads the use of which is authorized by RC-2. RC-2d is used when alternate routes of access are available over the authorized system and it is not known at the time of sale which route or routes will be used. This provision applies to CRUISE SALES ONLY.	The Purchaser is authorized to use the Smith River Access Road System which is under the jurisdiction of the Bureau of Land Management for the removal of Government timber sold under the terms of this contract; Provided, that the Purchaser shall pay the Government a road maintenance fee of ten (10) cents per thousand board feet per mile for the use of said roads. The total maintenance fee due shall be based upon estimated volumes set forth in Sec. 3(a) of this contract and mileage of roads used as determined by the Authorized Officer. In the event logs are hauled over more than one route, the estimated volume set forth in Sec. 3(a) shall be proportioned on the basis of actual volume removed. Prior to the use of such roads the Purchaser shall give written notice to the Authorized Officer of the roads he intends to use in the removal of the timber purchased under this contract, together with an estimate of the volume to be hauled over such roads. If the road maintenance fee does not exceed Five Hundred and no/100 Dollars ($500.00), the Purchaser shall pay such fee in full prior to use of such roads. If the total road maintenance fee exceeds Five Hundred and no/100 Dollars ($500.00), the Authorized Officer shall establish an installment schedule of payments of the maintenance fees.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-3 In the use of (describe road or roads) the Purchaser shall comply with the conditions (describe conditions of use).	Use RC-3 to reference easements or right of way agreements which permit use of third party lands or roads by the Purchaser. The conditions of use may be set out in the contract; a copy of the easement or right of way agreement attached, or the availability of such document noted.	In the use of the Deer Creek Road across the SW¼, Sec. 12, T. 12 S., R. 6 W., W.M., the Purchaser shall comply with the condition of Right-of-Way and Road-Use Agreement No. M-500 dated February 3, 1962, between the United States of America and ABC Lumber Company. This document is available for inspection at the office of the Authorized Officer.
RC-3a In accordance with 43 CFR 2234.2-3(b)(19)(e) the following allowances have been made for amortization or capital investment of the road covered by road agreement (give number) with the Purchaser. (Insert schedule which identifies road and amount of allowances.) It is understood that the purchase price stated in Sec. 2 of this contract is the net price because of such allowances.	RC-3a must be included in every contract where the Purchaser will use roads covered by a road agreement which the Purchaser executed as a permittee pursuant to 43 CFR 2234.2-3.	In accordance with CFR 2234.2-3(b)(19)(e) the following allowances have been made for the amortization on capital investment of the road covered by road agreement M-500 with the Purchaser: (1) One Thousand Five Hundred and no/100 Dollars ($1,500.00) for Smith Creek Road from west boundary of Sec. 12, T. 16 S., R. 12 W., W.M., to east boundary of Sec. 24, T. 16 S., R. 11 W., W.M. (2) Six Hundred and no/100 Dollars ($600.00) for the installation of Smith River Bridge #1. It is understood that the purchase price stated in Sec. 2 of the contract is the net price and no deduction will be made for the purchase price because of such allowance.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-2e Provided, that the Purchaser shall pay a road maintenance fee of (specify amount) per thousand board feet log scale per mile for the use of said roads. The total maintenance fee due shall be based upon volumes determined pursuant to Sections 2 and 3 of this contract and mileage of roads used as determined by the Authorized Officer. Prior to the use of such roads, the Purchaser shall give written notice to the Authorized Officer of the roads he intends to use in the removal of timber purchased under this contract, together with an estimate of the volume to be hauled over such roads. The Authorized Officer shall establish an installment schedule of payment of the maintenance fee. If it is determined by the Authorized Officer, after all merchantable timber has been cut and scaled, that the total maintenance fee payments made under this contract exceed the total maintenance fee payment due, such excess shall be returned to the Purchaser within sixty (60) days after such determination is made.	Add RC-2e to RC-2 when the Purchaser is required to pay a road maintenance fee to the Government for roads, the use of which is authorized by RC-2. RC-2e is for use with SCALE SALES ONLY and it may be used with either fixed or alternate routes of access.	The Purchaser is authorized to use the Smith River Access Road System which is under the jurisdiction of the Bureau of Land Management for the removal of Government timber sold under the terms of the contract; Provided, that the Purchaser shall pay a road maintenance fee of ten (10) cents per thousand board feet log scale per mile for the use of said roads. The total maintenance fee due shall be based upon volumes determined pursuant to Sec. 3 of this contract and mileage of roads used as determined by the Authorized Officer. Prior to the use of such roads, the Purchaser shall give written notice to the Authorized Officer of the roads he intends to use in the removal of timber purchased under this contract, together with an estimate of the volume to be hauled over such roads. The Authorized Officer shall establish an installment schedule of payment of the maintenance fee. If it is determined by the Authorized Officer, after all merchantable timber has been cut and scaled, that the total maintenance fee payments made under this contract exceed the total maintenance fee payment due, such excess shall be returned to the Purchaser within sixty (60) days after such determination is made.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
RC-3b In accordance with the terms and conditions of right of way permit (give number) the Government is hereby granted an allowance of (specify amount) as payment towards the Government's share of the replacement costs of (name or describe road). It is understood that the purchase price stated in Sec. 2 of this contract is the net price and that no deduction will be made from the purchase price because of such allowance.	RC-3b must be included in every contract where the Purchaser will use roads covered by a detailed permit which the Purchaser executed as a permittee pursuant to 43 CFR 2234.2-3.	In accordance with the terms and conditions of right of way permit M-500, the Government is hereby granted an allowance of Five Hundred and no/100 Dollars ($500.00) as payment towards the Government's share of the replacement costs of the Smith Creek Road from the west boundary of Sec. 12, T. 16 S., R. 12 W., W.M. to the east boundary of Sec. 24, T. 16 S., R. 12 W., W.M. It is understood that the purchase price stated in Sec. 2 of this contract is the net price and that no deduction will be made from the purchase price because of such allowance.
E-1 In addition to the requirements set forth in Sec. 23 (or Sec. 22 of Contract Form 5430-4) of this contract, the Purchaser shall (identify measures required which are considered above the normal requirements of Sec. 23 or Sec. 22.	Use E-1 when special problems are encountered in the contract area which require treatment in excess of that normally expected of the Purchaser under the terms of Sec. 23 of Form 5430-3 or Sec. 22 of Form 5430-4.	(1) In addition to the requirements set forth in Sec. 23 of this contract, the Purchaser shall remove existing logs and debris from Deer Creek where it flows through the contract area and shall restore any banks damaged by such removal. (2) In addition to the requirements set forth in Sec. 23 of this contract, the Purchaser shall seed all skid roads with rye grass applied at the rate of 10 pounds per acre.
SD-1 In addition to the requirements of Sec. 15 (or Sec. 14 of Contract Form 5430-4)of this contract, the Purchaser shall lop and scatter all slash (give location) concurrently with normal felling operations. All top and side branches must be free of the central stem so that such stem is reduced to the extent that it is within (specify height) inches of the ground at all points.	Use SD-1 when a Purchaser will be required to lop and scatter slash on the contract area.	In addition to the requirements of Sec. 15 of this contract, the Purchaser shall lop and scatter all slash over the entire cutting area concurrently with the normal felling operation. All top and side branches must be cut free of the central stem so that such stem is reduced to the extent that it is within twelve (12) inches of the ground at all points.

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
SD-2 In addition to the requirements of Sec. 15 (or Sec. 14 of Contract Form 5430-4) of this contract, the Purchaser shall pile and burn all slash located within (specify distance) feet on each side of (specify road or roads to which the provision applies). Slash shall be piled by (specify method).	Use SD-2 to require piling and burning of slash adjacent to specified roads on the contract area.	In addition to the requirements of Sec. 15 of the contract, the Purchaser shall pile and burn all slash within one hundred (100) feet on each side of each road on the contract area. Slash shall be piled by hand
SD-3 In addition to the requirements of Sec. 15 (or Sec. 14 of Contract Form 5430-4) of this contract, the Purchaser shall pile and burn all slash situated in (specify location). Slash shall be piled by (specify method).	Use SD-3 to require the Purchaser to treat slash in a specific manner on specific areas.	In addition to the requirements of Sec. 15 of this contract, the Purchaser shal pile and burn all slash situated in the partial cut area as approximately shown on Exhibit A. Slash shall be piled by a tractor equipped with a special brush piling blade.
M-1 The Purchaser agrees that the United States, its power permittees, lessees, and licensees, shall not be responsible or held liable or incur any liability for the damage, destruction or loss of any land, crops, facility installed or erected, income, or other property or investment resulting from the use of such lands or portions thereof for power developments at any time where such power development is made by or under the authority of the United States.	M-1 is required to be included in all timber sales located in lands classified, withdrawn, or reserved for power purposes. See BLM Manual 5403.	

Special Provisions

PROVISIONS	INSTRUCTIONS	EXAMPLE
M-2 The Government at its option may check scale any portion of the timber removed from the contract area. The Purchaser hereby agrees to make such contract timber available for scaling at a location designated by the Authorized Officer. If the entire sale is check scaled, the purchase price of this contract shall be reduced by $__________. In the event only a portion of the contract timber is scaled, the purchase price shall be reduced by that portion of $________, equal to the percentage of timber sold which was actually scaled by the Government. For purposes of computing this price reduction, the percentage of timber sold which has been scaled shall be determined by the Government. Any reduction in purchase price under the terms of this provision shall be full compensation to the Purchaser for any expense or loss incurred as a result of such scaling.	For optional truck scale checks of lump sum sales when qualified BLM scalers are available. Pending revision of Form 5430-3,* add reference to Sec. 38 to Sec. 2 of the contract by typing the number 38 in the right hand margin immediately following the words, ...in accordance with Sec. 7. No allowance is made in timber appraisal for check scaling. Purchaser is not required to pay for overtime scaling or provide a scale platform. Provision allows quality check of cruising. All or part of a sale may be check scaled. Compute truck delay cost for entire sale volume from latest Logging Cost Schedule. Use on contracts of highly defective, high value, old growth timber. See special provision L-14 for check scale of cruise plot. *Form 5430-3 to be renumbered Form 5450-3.	The Government at its option may check scale any portion of the timber removed from the contract area. The Purchaser hereby agrees to make such contract timber available for scaling at a location designated by the Authorized Officer. If the entire sale is check scaled, the purchase price of this contract shall be reduced by $114.00. In the event only a portion of the contract timber is scaled, the purchase price shall be reducod by that portion of $114.00, equal to the percentage of timber sold which was actually scaled by the Government. For purposos of computing this price reduction, the percentage of timber sold shall be determined by the Government. Any reduction in purchase price under the terms of this provision shall be full compensation to the Purchaser for any expense or loss incurred as a result of such scaling.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provision		
RC-4 The Purchaser shall undertake no logging operation on the contract area until he has secured from the appropriate official of the (describe public agency) permission for the use of the existing (describe public agency) road which traverses (describe terminal road by legal description) and permission to construct a new road from the existing road leading from such existing road across (describe public land) in (describe terminal road by legal description) to the contract area.	Use RC-4 when it is necessary to use or construct roads off the contract area on lands which are not owned or controlled by the Bureau of Land Management.	The Purchaser shall undertake no logging operation on the contract area until he has secured from the appropriate official of the Forest Service, U.S. Department of Agriculture, permission for the use of the existing Forest Service road which traverses Section 26, T. 40 N., R. 30 E., M.D.M. and permission to construct a new road leading from such existing road across National Forest land in Sections 26 and 27 T. 40 N., R. 30 E., M.D.M. to the contract area.
L-15 In the (give location) shown on Exhibit A, all trees except those reserved, shall be felled parallel to the contour of the slope and prior to falling trees, except (right-of-way) trees, on the adjacent slope in (give location) above the (give location).	Use L-15 to require contour felling of trees in a clear cut area immediately adjacent and above a buffer strip to prevent timber from sliding into the buffer strip.	In the Special Cutting Area shown on Exhibit A, all trees, except those reserved, shall be felled parallel to the contour of the slope and prior to felling trees, except right-of-way trees, on the adjacent slope in Area #4 above the Special Cutting Area.
L-16 In that portion of the (specify location) on which required skyroads are designated on the ground with (describe how area is marked) and as shown on Exhibit A, the Purchaser shall use a skyline or similar cable system capable of transporting logs completely clear of the ground and capable of yarding (specify distance) feet slope distance from the landing and at least (specify distance) feet laterally from the skyline to the designated skyroad and with minimum damage to reserved trees.	Use L-16 to regulate the type and use of logging equipment to be used on an area.	In that portion of the partial cutting area on which required skyroads are designated on the ground with blue ribbon and as shown on Exhibit A, the Purchaser shall use a skyline or similar cable system capable of transporting logs completely clear of the ground and capable of yarding two thousand (2000) feet slope distance from the landing and at least one hundred and seventy (170) feet laterally from the skyline to the designated skyroad and with minimum damage to reserved trees.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provisions	Instructions	Example
F-1 Prior to construction or logging under this contract, the Purchaser shall prepare a fire prevention and fire control plan to the satisfaction of the Authorized Officer.	Use F-1 in contracts operating during periods of fire danger	
F-2 The Purchaser shall provide and maintain in good repair on the contract area the following equipment for use during periods of fire danger.	Use F-2 as a preamble for other "F" provisions. F-2 may not stand alone but must be supplemented by the addition of other "F" provisions.	
F-2a Fire fighting tools shall be kept at each landing or at such other place as the Authorized Officer shall designate whenever men are working on the contract area. All fire fighting tools shall be kept in a sturdily constructed box which shall be painted red and lettered on the front or top in large letters, "For Fire Only." The box shall have a hinged lid and a hasp by which the lid can be sealed. One box may serve two landings not over six hundred (600) feet apart. When filled, the box shall not weigh over two hundred (200) pounds. The fire tools shall be in good condition, be tight on strong handles, and have sharp cutting edges. There shall be not less than four tools in each box nor less than one tool for each man working on the contract area. Three-fourths of all fire tools shall be shovels, hazel hoes, or other scraping tools. The fire tools shall be used only for fighting fire.	Add-F2a to F-2 in contracts during periods of fire danger.	
F-2b A shovel in good condition with not less than a three (3) foot handle and a blade not less than seven and three-quarters (7 3/4) inches wide shall be within fifty (50) feet of any power saw when in operation.	Add F-2B to F-2 in operating during periods of fire danger.	

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provisions	Instructions	Example
F-2c At each landing during periods of operation (specify number) tank truck(s) of (specify amount) gallons or more capacity with (specify amount) feet of hose and a nozzle acceptable to the Authorized Officer and a mounted or portable pump conforming to the standards set forth in (specify state forest law number). (Specify number) (specify gallons) tank trucks or portable tanks may be substituted for each required (specify gallons) tank truck, provided that the total capability to pump and deliver water remains unchanged. All hose couplings shall have the standard thread adopted by the State Fire Marshall pursuant to (specify state forest law number) or be provided with suitable adapters. At the close of each working day, all bulldozers and tank trucks shall be filled with fuel and made ready for immediate use. All tank trucks and portable tanks shall be filled with water and made available for immediate use.	Add F-2c to F-2 when it is desirable to require additional fire equipment.	At each landing during periods of operation, one (1) tank truck of one thousand (1000) gallons or more capacity with one thousand (1000) feet of hose and a nozzle acceptable to the Authorized Officer and a mounted or portable pump conforming to the standards set forth in Oregon Revised Statutes 477.650(2)(a). Two (2) five hundred (500) gallon tank trucks or portable tanks may be substituted for each required one thousand (1000) gallon tank truck, provided that the total capability to pump and deliver water remains unchanged. All hose couplings shall have the standard thread adopted by the State Fire Marshall pursuant to Oregon Revised Statute 476.030 or be provided with suitable adapters. At the close of each working day, all bulldozers and tank trucks shall be filled with fuel and made ready for immediate use. All tank trucks and portable tanks shall be filled with water and made available for immediate use.
F-2d Serviceable radio or radiotelephone equipment able to provide prompt and reliable communication between the contract area and (City and State). Such communication shall be available during periods of operation including the time watchman service is required.	Add F-2d to F-2 when it is desirable to require communication equipment.	Serviceable radio or radiotelephone equipment to provide prompt and reliable communication between the contract area and Prineville, Oregon. Such communication shall be available during periods of operation including the time watchman service is required.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provision	Instructions	Examples
RC-1e Upon completion of (specify practice), the Purchaser shall scarify the entire road as shown on (identify exhibit) in strips of not more than (specify width) in width to a minimum depth of (specify depth) to prepare the road for reforestation provided that no scarification shall be required where the road traverses rock outcroppings. All natural water courses shall be opened to prevent erosion of the road. Barriers shall be constructed so as to prevent further use of the road by vehicles.	Add RC-1e to RC-1 to require rehabilitation of temporary roads no longer needed for management purposes.	The Purchaser shall construct the Bear Creek Road to the satisfaction of the Authorized Officer in a good and workmanlike manner, in conformity with law, and in accordance with the plans and specifications listed on Exhibit B and the location shown on Exhibit C. Upon completion of logging operations and slash disposal, the Purchaser shall scarify the entire road as shown on Exhibit C in strips of not more then eighteen (18) inches in width to a minimum depth of ten (10) inches to prepare the road for reforestation, provided that no scarification shall be required where the road traverses rock outcroppings. All natural water courses shall be opened to prevent erosion of the road. Barriers shall be constructed so as to prevent further use of the road by vehicles.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provisions	Instructions	Example
RC-2f Provided that at all times the Purchaser shall put, maintain, and leave the (give road name and number) in a condition satisfactory to the Authorized Officer during the period of his operations on the contract area; provided, however, that at any time the Authorized Officer may by written notice terminate the Purchaser's operator road maintenance obligations and require instead payment of a road maintenance fee of (specify amount) per M board feet per mile, said amount to be applied to the remaining contract volume on the sale area to be transported over (give road name and number). The Purchaser shall pay the total maintenance fee for said road within thirty (30) days following receipt of written notice; provided, however, if the total amount exceeds Five Hundred Dollars (\$500.00), the Purchaser may elect to make payment in equal installments in the same manner as regular contract installment payments.	Add RC-2f to RC-2 when it is determined that road maintenance responsibility should be shifted from the Purchaser to the Bureau during the life of the contract. The method of determining the remaining contract volume on the sale area at the time of maintenance conversion, which, in turn, will establish the fee to be collected, will be of vital concern to prospective purchasers. The procedure should be explained in detail at the time of the sale. Advise prospective purchasers that the volume determination shall be made by the Authorized Officer, and will not be subject to arbitration.	The Purchaser is authorized to use the Kelsey-Mule Creek Access Road, which is under the jurisdiction of the Bureau of Land Management, from SW1/4SW1/4, Sec. 14, T. 32 S., R. 9 W., W.M. to SE1/4NE1/4, Sec. 13, T. 32 S., R. 8 W., W.M., for the removal of Government timber sold under this contract; provided that at all times the Purchaser shall put, maintain, and leave the Kelsey-Mule Creek Access Road in a condition satisfactory to the Authorized Officer during the period of his operations on the contract area; provided, however, that at any time the Authorized Officer may by written notice terminate the Purchaser's operator road maintenance obligations and require instead payment of a road maintenance fee of ten (10) cents per M board feet per mile, said amount to be applied to the remaining contract volume on the sale area to be transported over the Kelsey-Mule Creek Access Road. The Purchaser shall pay the total maintenance fee for said road within thirty (30) days following receipt of written notice; provided, however, if the total amount exceeds Five Hundred Dollars (\$500.00), the Purchaser may elect to make payment in equal installments in the same manner as regular contract installment payments.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provisions	Instructions	Example
See E-1, page 12	Use these modifications of E-1 when special problems are encountered on the contract area. Examples (3) and (4) are for use on community watersheds.	(3) In addition to the requirements set forth in Sec. 23 of this contract, the Purchaser shall not employ any workman with a history of having had typhoid, amoebic dysentery, or infectious hepatitis. A health certificate to this effect must be filed with the Authorized Officer for each employee.
		(4) In addition to the requirements set forth in Sec. 23 of this contract, the Purchaser shall establish pit privies, chemical toilets, or water-tight vault-type privies convenient to all principal points of operation. Pits shall be of such depth that contents may be buried at least three (3) feet below the surface before the site is abandoned. At no time shall any pit privie be allowed to fill to within three (3) feet of the ground surface before being backfilled with earth. No privy shall be located closer than three hundred (300) feet from the stream or tributary and sites as nearly level as possible shall be selected. Vault-type privies shall receive proper servicing and maintenance and the waste material shall be disposed of in a manner approved by the local health department and the State Board of Health. Employees shall use the toilet facilities provided. Employees shall be notified of sanitary regulations and fully instructed as to their meaning and importance. The Purchaser is responsible for enforcing the sanitary regulations. No camps shall be allowed.
		(5) In addition to the requirements set forth in Sec. 23 of this contract, the Purchaser shall furnish to the Government fifty (50) pounds of (fescue) (rye) (crested wheat grass) (highland bent) grass seed for seeding by the Government in the (contract area) (on cuts and fills of the road to be constructed by the Purchaser). 1/
		(6) In addition to the requirements set forth in Sec. 23 of this contract, the Purchaser shall seed (the slopes of all cuts and fills of the Deer Creek Road) with (fescue) (rye) grass to create a sufficient cover to prevent erosion.

1/ Select appropriate grass mixture for area.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provisions | Instructions | Example

(8) In addition to the requirements set forth in Sec. 23 of this contract, the Purchaser shall complete seeding, fertilizing, and mulching on cuts, fills, and waste areas as designated by the Authorized Officer along all sections of roadway excavated during the year prior to October 1 of each year. Seeding, fertilizing, and mulching will not be required on cut slopes in areas of rock material. The Authorized Officer may set time limits for the beginning and completion of erosion control measures. Grass seed, fertilizer, mulch, and suitable equipment to apply these materials shall be furnished by the Purchaser. This equipment and materia shall be furnished by the Purchaser. The equipment and material shall be approved in writing by the Authorized Officer prior to the start of the seeding, fertilizing and mulching operation.

The grass seed mixture shall be mixed in the following proportions by weight and furnished in sealed containers. Grass seed which has become wet, moldy, or otherwise damaged, will not be used.

Alta Fescus	45%
Creeping Red Fescue	20%
Annual Rye Grass	20%
Dutch White Clover (Inoculated)	15%

All seed used shall meet all requirements of the Federal Seed Act (7 U.S.C. Secs. 1551-1610, incl.) and the seed laws and noxious weed laws of Oregon. Evidenc of seed certification shall be furnished at the request of the Authorized Officer. All leguminous seed will be inoculated with approved cultures in accordance with instructions of the manufacturer. The seed used shall meet the following requirements.

Purity	95.0% minimum
Germination	85.0% minimum
Weed Content	0.5% maximum

Fertilizer shall be water soluble commercial fertilizer supplied in combination containing the following ratio:

Available nitrogen	16
Available phosphoric acid	20
Potassium	0

Mulch shall consist of straw, hay, or specially prepared wood cellulose fiber processed in such a manner that it contains no growth or germination inhibiting factors and shall be free of noxious weed seed.

5424 - PREPARATION OF CONTRACT AND EXHIBITS

Special Provisions

Provisions	Instructions	Example
		The Purchaser shall apply grass seed, fertilizer, and mulch uniformly on the designated areas at a rate to give the following coverage per acre:

Grass seed	40 pounds per acre
Fertilizer	200 pounds per acre
Mulch	4,000 pounds per acre

No seed, fertilizer or mulch shall be applied when wind velocities will prevent uniform application of the material on the designated areas.

3-22-74

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

No. 36110- TS 4-60

CONTRACT FOR THE SALE OF TIMBER

NW

LUMP SUM SALE

Adv. O&C

THIS CONTRACT is made and entered into the day of MAR 22 1974, 19 , under the authority of the Act of August 28, 1937, (50 Stat. 874), as amended, (43 U.S.C. Sec. 1181a–f), relating to the revested Oregon and California Railroad and reconveyed Coos Bay Wagon Road grant lands, or under the Act of July 31, 1947, (61 Stat. 681), as amended, (30 U.S.C. Secs. 601–604), relating to other lands under the jurisdiction of the Bureau of Land Management, and the regulations as set forth in 43 CFR Group 5400, between the UNITED STATES OF AMERICA, hereinafter called the Government, acting through the Bureau of Land Management, and The Robert Dollar Co., a corporation of P. O. Box C, Glendale, Oregon 97442 hereinafter called the Purchaser.

WITNESSETH, That the parties hereto do mutually agree as follows:

Sec. 1. *Timber Sold.* The Government hereby sells to the Purchaser and the Purchaser hereby buys from the Government, under the terms and conditions of this contract, all timber, except that reserved to the Government under Sec. 40 of this contract, within the area designated by the Government, comprising the contract area* and situated in the County of Douglas State of Oregon, and described as follows:

TOWNSHIP	RANGE	SECTION	SUBDIVISION(s)
32 South	5 West	27	Lots 4, 5, 7, NW¼SW¼
		29	E½SW¼, S½SE¼
		33	Lots 4, 5, SW¼NE¼, NW¼, N½SW¼, NW¼SE¼
33 South	5 West	5	Lots 1, 2, 3, S½NE¼, SE¼NW¼

Sec. 2. Total Purchase Price – Purchaser agrees to pay Government, as the total purchase price for the timber sold hereunder, the sum of One million, two hundred sixty-three thousand, seven hundred fifty-three, and 25/100-------------------- dollars ($ 1,263,753.25---------); *Provided, however,* that such total purchase price may be adjusted in accordance with Secs. 6, 7, 8, 9, 19, 20, or 41 of this contract.

Sec. 3. Payment

(a) Payments under this contract shall be made as set forth in this section.

(b) Unless total purchase price is paid on or before the date this contract is signed by the Authorized Officer, payments shall be made in installments of not less than ten thousand and no/100-------------- dollars ($ 10,000.00------) as follows: (1) Except as provided in subsection (c) of this section, the first installment shall be paid on or before the date this contract is signed by the Authorized Officer; (2) Except as provided in subsection (c), (d), and (e) of this section, the second installment shall be paid prior to cutting or removal of any timber sold under this contract. Each subsequent installment shall become due and payable without notice whenever the value of timber cut or removed equals the sum of the second and subsequent installments paid by Purchaser. No timber may be cut or removed until such payment has been made. Purchaser shall continue to make such installment payments until the total purchase price has been paid.

(c) Payment of the first installment, required in subsection (b) of this section, may be delayed if Purchaser increases the performance bond as permitted by Sec. 38(b); *Provided, however,* that cash payment for said installment must be made (1) before cutting or removal of the last portion of timber sold having a value equal to the amount of the first installment, or (2) at any time when Government exercises its authority to cancel the rights of Purchaser in accordance with Sec. 10(a), whichever occurs first.

(d) If Purchaser increases its performance bond, as permitted by Sec. 38(c), cutting of timber of a value not in excess of the increase in value of such bond may be permitted prior to payment of the second or subsequent installments; *Provided, however,* that no timber may be skidded or yarded to a loading point or removed from the contract area prior to payment of any installment which, but for the provisions of this subsection, would otherwise be due under the provisions of Sec. 3(b).

(e) If Purchaser provides a payment bond, as permitted by Sec. 38(e), cutting and/or removal of timber of a value not in excess of the penal sum of such bond may be permitted prior to the payment of the second or subsequent installments. Unless a shorter period is agreed to by Purchaser and Government, Government shall bill Purchaser monthly for timber skidded or yarded to a loading point or removed from the contract area. Such billing shall include any amount due for related road maintanance fees. Purchaser shall make payment within fifteen (15) days of the billing date shown on the billing form.

(f) For the purpose of determining (1) when payments are due or (2) the value of timber subject to any special bonding provision, Government shall calculate the value of timber in accordance with the provisions of *Exhibit B,* which is attached hereto and made a part hereof.

(g) Purchaser shall pay the total purchase price not later than the expiration of the time for cutting and removal as set forth in Sec. 4. Purchaser shall make all payments at the office of Authorized Officer in cash, or by money order, bank draft, or check made payable to the Bureau of Land Management.

(h) For any payments or other charge not paid when due, interest shall accrue on the unpaid amount at the rate of six (6) percent per annum, beginning fifteen (15) calendar days after the end of the payment period.

Sec. 4. Time for Cutting and Removal – Except as otherwise provided in this contract, Purchaser may begin cutting and removing timber sold under this contract on the date this contract is signed by the Authorized Officer. Purchaser's right to cut and remove such timber shall expire thirty-six---------------------------- (36) months after such date; *Provided, however,* extensions of time may be granted as provided in Sec. 9.

Sec. 5. Definitions

(a) *Authorized Officer* – any employee of the Bureau of Land Management to whom has been delegated the authority to take action in connection with this contract.

(b) *Timber* – standing trees, downed trees, or logs, which are capable of being measured in board feet.

(c) *Loading point* – any landing or other area in which logs are capable of being loaded for transportation out of the contract area; *Provided, however,* that right-of-way timber which has been cut shall not be considered to be at a loading point until such time as logs from any source are actually transported over that portion of the right-of-way.

Sec. 6. Inspection of Timber and Disclaimer of Warranty

(a) Purchaser warrants that this contract is accepted and executed on the basis of its examination and inspection of the timber sold under this contract and its opinion of the value thereof.

(b) Government expressly disclaims any warranty of fitness of the timber for any purpose; all timber sold hereunder is accepted *As Is* without any warranty of merchantability by Government. Any warranty as to the quantity or quality of the timber sold hereunder is expressly disclaimed by Government. Refund to or recovery by Purchaser for failure of title to any timber sold hereunder shall not exceed the value of such timber computed at prices per unit for species involved as set forth in *Exhibit B.*

Sec. 7. Passage of Title and Risk of Loss – Title to timber sold under this contract shall remain in Government and shall not pass to Purchaser until such timber has been paid for and removed from the contract area. Unless cut timber is sold under this contract, risk of loss shall be borne by Purchaser after the timber is cut; *Provided, however,* that if loss results from a fire which was not caused by Purchaser, his contractors, subcontractors, or the employees of any of them, the risk of loss shall be borne by the party holding title. If cut timber is sold under this contract, risk of loss shall be borne by the party holding title. Risk of loss to Government shall

---

* *General location of contract area is shown on map marked Exhibit A which is attached hereto and made a part hereof*

Appendix B

not exceed the value of such timber computed at the prices per unit for the species involved as set forth in *Exhibit B*. Nothing herein shall be construed to relieve either party from liability for any breach of contract or any wrongful or negligent act. As used in this section, the term *cut timber* refers only to timber which has been felled, bucked, or otherwise severed by direct human activity prior to the date this contract was entered into.

Sec. 8. Sales of Additional Timber – If the Authorized Officer and Purchaser agree that additional timber should be removed and the Authorized Officer determines that the sale will not be detrimental to the interests of Government and is within the provisions of 43 CFR 5402.0–6, the Authorized Officer shall grant written permission to Purchaser to cut and remove such timber. If permission is granted, Purchaser shall pay for such timber at a price determined by the Authorized Officer in accordance with the Bureau of Land Management prescribed procedures. The value and volume of such timber shall be added to *Exhibit B* and the value thereof shall be added to total purchase price in Sec. 2. Payment for such timber shall be made in accordance with Sec. 3(b) or 3(e), except that, if all contract payments required by Sec. 3(b) or 3(e) have been made, payment for such timber shall be made in advance as a condition of granting such permission.

Sec. 9. Extension of Time and Reappraisal – If Purchaser shows that delay in cutting and removal was due to causes beyond his control and without his fault or negligence, the Authorized Officer may grant an extension of time, not to exceed one year, upon written request of Purchaser. Such written request shall be filed with the Authorized Officer prior to the expiration of the time for cutting and removal expressed in Sec. 4. If an extension of time is granted, as provided in this section, timber remaining on contract area shall be reappraised by the Authorized Officer, using Bureau of Land Management prescribed procedures, and the total purchase price adjusted accordingly; *Provided, however,* no adjustment shall be made by reason of timber being enhanced in value by Purchaser, nor shall the reappraised total purchase price be less than the total purchase price in effect during the original time for cutting and removal or the last extension. The Authorized Officer may require that the reappraised total purchase price shall be paid in advance as a condition of granting an extension. Market fluctuations shall not be cause for consideration of contract extensions.

Sec. 10. Violations, Suspension, and Cancellation

(a) If Purchaser violates any provision of this contract, the Authorized Officer may, by written notice, suspend any further operations of Purchaser under this contract, except such operations as may be necessary to remedy the violation. If Purchaser fails to remedy the violation within thirty (30) days after receipt of a suspension notice, the Authorized Officer may, by written notice, cancel the rights of the Purchaser under this contract and take appropriate action to recover all damages suffered by Government by reason of such violation, including application toward payment of such damages of any advance payments and any performance bonds or, where applicable, any payment bonds; *Provided, however,* that if the violation involves nonpayment of amounts due for timber cut and/or removed under a payment bond of a corporate surety, the Authorized Officer must, in addition to the above requirements, allow sixty (60) days after making demand upon surety for any payment due before cancelling the rights of Purchaser.

(b) If Purchaser cuts or removes any timber sold under this contract during any period of suspension, such cutting or removal shall be considered a wilful trespass and render Purchaser liable for damages under applicable law. Any payment made for purchase price of timber cut or removed in trespass shall be deducted to the extent of single damages or the value of timber under this contract, whichever is lesser, from amount due because of trespass.

(c) If Purchaser's operations are suspended because of Purchaser's failure to make an installment payment when due, the Authorized Officer may require Purchaser to pay the entire remaining balance of the purchase price as a condition of terminating the suspension.

(d) If Purchaser, his contractors, subcontractors, or the employees of any of them, cuts, injures, or removes any Government timber reserved under this contract, they shall fully cooperate, upon request of the Authorized Officer, in the investigation of such acts. If in the opinion of the Authorized Officer, full cooperation is not received or will not be forthcoming, he may suspend that portion of Purchaser's operations necessary to preserve evidence pending investigation or permit safe investigation of such acts.

Sec. 11. Credit Against Purchase Price – If the time specified for cutting and removal of timber has expired or the rights of Purchaser have been cancelled, Purchaser shall be entitled to a credit against any amount which is due and owing Government for timber remaining on the contract area. The Authorized Officer shall determine the credit value of the remaining timber as soon as possible after the date of expiration or cancellation. Credit value of the remaining timber shall be total market value, as established by the Authorized Officer by reappraisal or resale, or total value based upon contract unit prices, whichever is less. There shall be deducted from credit value such amounts as the Authorized Officer determines adequate to cover costs to Government resulting from Purchaser's failure to perform, including but not limited to costs of appraising and administering any resale of timber.

Sec. 12. Responsibility for Damage Suffered, Cost, or Expense Incurred by Government – Purchaser shall be liable for any damage suffered, cost, or expense incurred by Government arising out of any operations under this contract whenever such damage, cost, or expense results from any breach of contract or wrongful or negligent act of Purchaser, his contractors, subcontractors, or the employees of any of them. Purchaser shall pay Government for such damage, cost, or expense after written demand therefor by the Authorized Officer.

Sec. 13. Timber Trespass – If in connection with operations hereunder Purchaser, his contractors, subcontractors, or the employees of any of them, cuts, injures, or removes any Government timber, other than timber sold under this contract, Purchaser shall be liable for damages under applicable law. Purchaser shall pay Government for such damages after written demand therefor by the Authorized Officer.

Sec. 14. Protection of Utilities and Improvements – Existing telephone, telegraph and transmission lines, fences, ditches, roads, trails, and other improvements shall be protected as far as practicable in all phases of Purchaser's construction or logging operations. All roads and trails, designated by the Authorized Officer as needed for fire protection or other purposes, shall be kept free of logs, slash, and debris. Damage to utilities and improvements shall be promptly paid for or repaired to a condition which, in the opinion of the Authorized Officer, is at least as good as the condition just prior to such damage.

Sec. 15. Fire Prevention and Slash Disposal – Purchaser shall take such measures for prevention and suppression of fire on the contract area and other adjacent Government lands or other Government lands used or traversed by Purchaser in connection with operations as are required by applicable laws and regulations. *However,* when in the opinion of the Authorized Officer, weather and other conditions affecting fire incidence and control make special precautions necessary to protect the contract area and said Government lands, Purchaser shall take such additional or other fire prevention and control measures as may be required by the Authorized Officer. Disposal of slash shall be done in accordance with a plan approved by the Authorized Officer.

Sec. 16. Construction, Use and Maintenance of Roads and Facilities

(a) Subject to the written approval of and regulation by the Authorized Officer, Purchaser may: (1) construct and use any new roads and facilities not otherwise provided for in this contract, and (2) use any existing roads and facilities not otherwise provided for in this contract.

(b) Except as provided in Sec. 12, Purchaser shall perform or pay for repair and maintenance of any road or facility used under the terms of this contract in accordance with the requirements of Sec. 41; *Provided, however,* that Purchaser shall not be responsible for maintenance or repair of wear or damage caused by third parties, or maintenance or repair which exceeds the standards of required maintenance shown in Sec. 41; and *Provided, further,* that Purchaser's responsibility under this provision shall not commence prior to the date on which he first begins operations and shall cease upon completion and written acceptance of all contract requirements other than slash disposal, except for maintenance and repair of damages resulting from Purchaser's slash disposal activities.

Sec. 17. Limitations of Road Use

(a) Purchaser's right under this contract to use existing Government roads described herein, or roads to be constructed, is limited to removal of timber sold under this contract; *Provided, however,* that this provision shall not limit any right to use Government roads or rights-of-way which have been granted to Purchaser pursuant to 43 CFR Group 2800.

(b) For the purpose of protecting roads described herein, Purchaser shall immediately discontinue use of said roads upon receipt of written notice that the Authorized Officer has determined that continued use will cause excessive damage to said roads.

Sec. 18. Acceptance of Road Construction

(a) Whenever Purchaser shall deliver to the Authorized Officer a written statement that the road construction is complete, pursuant to the contract terms, the Authorized Officer shall promptly inspect such road. If the contract road construction requirements have been completed to the satisfaction of the Authorized Officer, Purchaser will be given written notice of acceptance, and, except as provided in Sec. 12, be released from further liability or duty for construction or reconstruction of such road.

(b) Notwithstanding acceptance of any road under this section, Purchaser shall remain liable for maintenance and repair of any such road in accordance with the provisions of Sec. 16.

Sec. 19. Cost Adjustment for Physical Changes – If, prior to acceptance of a road under Sec. 18, a major physical change, caused by a single event, and not due to negligence of Purchaser, his contractors, subcontractors, or the employees of them, results in additional work by Purchaser olving an additional estimated cost of more than (1) $1,000 or sales under one million board feet; (2) $1.00 per thousand board feet for sale of one to three million board feet; or (3) $3,000 for sales over three million board feet, Government shall become responsible for any estimated cost which exceeds the above amounts. Government may elect to meet its share by reducing the purchase price or by payment of such cost to Purchaser or by performing its share of the necessary work. The estimated cost of additional work shall be calculated by the Authorized Officer using Bureau of Land Management prescribed appraisal procedures. Such cost shall include the cumulative estimated costs of repairing damage from slides, washouts, landslips, fire, etc. caused by said event. If necessary, plans and specifications shall be revised to meet the new conditions. Purchaser must obtain advance approval from the Authorized Officer for such additional work in order for Purchaser to be eligible for cost adjustment under this section.

Sec. 20. Design Change — If Purchaser and the Authorized Officer agree on a design change of a substantial nature in any road, road structure, or bridge required to be constructed or improved under the terms of this contract, the total purchase price shall be revised to reflect the estimated increase or decrease in cost resulting from such design change. A design change of substantial nature is one that would result in a cost adjustment of $1,000 or more.

Sec. 21. Rights and Obligations After Time for Removal of Personal Property or *Cancellation of the Rights of the Purchaser* — If any of Purchaser's obligations remain unperformed after expiration of the time for removal of personal property, as set forth in Sec. 39, or if the rights of Purchaser under this contract have been cancelled by Government, all provisions of this contract for the benefit and protection of Government or third parties shall remain in effect until this contract is terminated in its entirety by Government.

Sec. 22. Protection of Survey Monuments, Witness Corners, Reference Monuments, and Bearing Trees — Purchaser shall protect all survey monuments, witness corners, reference monuments, and bearing trees against destruction, obliteration, or damage during operations on the contract area. If any monuments, corners, or accessories are destroyed, obliterated, or damaged by such operations. Purchaser shall hire an appropriate county surveyor or registered land surveyor to reestablish or restore the monuments, corners, or accessories, at the same location, using surveying procedures in accordance with the *Manual of Instructions for the Survey of the Public Lands of the United States*, and shall record such survey in appropriate county records. The Authorized Officer may prescribe in writing additional requirements for protection of monuments, corners, and bearing trees.

Sec. 23. Purchaser's Representative — At all times when construction or logging operations are in progress, Purchaser shall have a representative readily available in the area of such operations who shall be authorized to receive, in behalf of Purchaser, any notices or instructions from the Authorized Officer in regard to performance under this contract. Purchaser shall take such action as is required by the terms of this contract.

Sec. 24. Simultaneous Use of Contract Area by Others — If the Authorized Officer determines that other use of the contract area will not seriously interfere with the operations of Purchaser, he may issue permits, leases, or contracts for the simultaneous use of the contract area by others.

Sec. 25. Watershed Protection: Water Quality, Erosion Control and Soil Damage

(a) Purchaser shall comply with all applicable State and Federal laws and regulations pertaining to water quality in connection with any operations under this contract.

(b) Purchaser shall take every reasonable precaution not to pollute or obstruct any stream, lake, or reservoir on or near the contract area in connection with any operations under this contract. If Purchaser's operations cause pollution or obstruction of any stream, lake, or reservoir on or near the contract area, Purchaser shall correct the condition to the satisfaction of the Authorized Officer.

(c) Purchaser shall undertake every reasonable measure to minimize erosion and soil damage in connection with any operations under this contract, including but not limited to construction of water bars on yarding and spur roads as designated by the Authorized Officer. Purchaser shall immediately discontinue any construction or timber harvesting operations under this contract, upon receipt of written notice from the Authorized Officer that due to weather or soil moisture conditions, such operations will cause excessive damage to the soil. The Authorized Officer shall notify Purchaser, in writing, when such operations may be resumed.

Sec. 26. Refuse Control and Disposition of Waste Materials

(a) Purchaser shall, to the satisfaction of the Authorized Officer, remove, or otherwise dispose of all garbage, temporary buildings, trash, litter, discarded equipment or parts, waste materials or other refuse resulting from Purchaser's operations. Areas for disposal of waste material shall be subject to approval of the Authorized Officer.

(b) Waste materials, such as garbage, trash, oil, grease, chemicals and similar substances shall be disposed of in a manner that will prevent their entry by drainage, high water, or other means into any river, watercourse, lake, or reservoir in or near Purchaser's operations. Water used to wash down equipment used for petroleum products, industrial chemicals, cement or other toxic materials shall be disposed of in a manner that will prevent their entry into any watercourse or waterway.

Sec. 27. Storage and Handling of Hazardous Materials — All petroleum products, industrial chemicals and similar toxic or volatile materials stored by Purchaser on or near the contract area, in connection with operations under this contract, shall be stored in durable containers and shall be stored in areas, as determined by the Authorized Officer, which are either located so that any accidental spillage will not drain into any watercourses, lakes, or reservoirs or, when such areas are not available, shall be stored in an area surrounded by impermeable containment dikes of sufficient capacity to contain the aggregate capacity of all tanks.

In addition, Purchaser shall comply with all applicable State and Federal laws and regulations concerning the storage, handling, use and disposal of industrial chemicals, pesticides, herbicides, and other hazardous substances.

Sec. 28. Safety and Health — Purchaser shall conduct all operations in connection with this contract in compliance with the applicable provisions of Federal, State, and local safety, health and sanitation laws, codes, and regulations and shall make it possible for the Authorized Officer to inspect such operations.

Sec. 29. Equal Opportunity — During the performance of this contract, Purchaser agrees as follows:

(a) Purchaser will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin. Purchaser will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Purchaser agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this section.

(b) Purchaser will, in all solicitations or advertisements for employees placed by or on behalf of Purchaser, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

(c) Purchaser will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of Purchaser's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(d) Purchaser will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(e) Purchaser will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, as amended, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(f) In the event of Purchaser's noncompliance with this section, contract may be cancelled, terminated or suspended in whole or in part and Purchaser may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, as amended, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, as amended, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(g) Purchaser will include the provisions of paragraphs (a) through (g) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, as amended, so that such provisions will be binding upon each subcontractor, or vendor. Purchaser will take such action with respect to any subcontract, or purchase order, as the contracting agency may direct as a means of enforcing such provisions including sanctions for noncompliance: *Provided, however*, that in the event the Purchaser becomes involved in, or is threatened with, litigation with a subcontractor, or vendor as a result of such direction by the contracting agency, Purchaser may request the United States to enter into such litigation to protect the interests of the United States.

Sec. 30. Records and Reports — Upon request of the Authorized Officer, Purchaser shall furnish the following records and reports: (1) volume or quantity of timber cut and removed from the contract area; (2) road costs including road use fees paid in connection with removing timber from the contract area; and (3) prices received for lumber or other wood products.

Sec. 31. Unsatisfactory Bond — Whenever any performance or payment bond furnished under this contract becomes unsatisfactory to the Authorized Officer, he may require a new bond which is satisfactory to him.

Sec. 32. Assignments

(a) Purchaser may not assign this contract or any interest therein without written approval of the Authorized Officer. An assignment shall contain all the terms and conditions agreed upon by the parties thereto.

(b) The Authorized Officer will not approve any assignment involving contract performance unless assignee: (1) is authorized to transact business in the State indicated in Sec. 1; (2) submits such information as is necessary to assure the Authorized Officer of his ability to fulfill the contract; and (3) furnishes a performance bond as required by Sec. 38 or obtains a commitment from the previous surety to be bound by the assignment when approved. Upon approval of an assignment by the Authorized Officer, the assignee shall be entitled to all the rights and subject to all the obligations of this contract and the assignor shall be released from any further liability under this contract.

Sec 33 *Contingent Fees* — Purchaser warrants that no person or agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee excepting bona fide employees or bona fide established commercial agencies maintained by Purchaser for the purpose of securing business. For breach or violation of this warranty, Government shall have the right to cancel this contract without liability or, in its discretion, to require Purchaser to pay, in addition to the contract price or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

Sec. 34 *Successors in Interest* — Every obligation hereunder shall extend to and be binding upon the successors in interest of the parties hereto and every benefit hereunder shall inure to such successors.

Sec. 35. *Exercise of Rights or Duties of the Authorized Officer* — The rights or duties of the Authorized Officer may be exercised by the Authorized Officer or his designated representative.

Sec. 36. *Officials not to Benefit* — No Member of, or Delegate to Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4, shall be admitted to any share or part in this contract or derive any benefit that may arise therefrom, and the provisions of Section 3741 of the Revised Statutes of the United States, as amended (41 U.S.C. Sec. 22), and Sections 431, 432, and 433, Title 18, U.S.C., relating to contracts, enter into and form a part of this contract so far as the same may be applicable.

Sec. 37. *Appeal* — An appeal may be taken from any decision of any officer of the Bureau of Land Management to the Board of Land Appeals pursuant to the Rules of Practice (43 CFR Part 4 Subpart E).

Sec. 38. *Bond*

(a) A performance bond shall be filed by Purchaser on or before the date this contract is signed by the Authorized Officer in the amount of two hundred fifty-two thousand, eight hundred &$\frac{00}{0}$ dollars ($252,800.00).

(b) If Purchaser elects to increase the amount of the performance bond required above by an amount equal to the first installment, in order to secure the delayed payment of said installment, as provided in Sec. 3(c), increased bond shall be on a form approved by the Director of the Bureau of Land Management which upon completion must be approved, in writing, by the Authorized Officer. If a corporate surety bond is used, the bond shall provide that the Surety will pay to Government the amount of the increase within sixty (60) days after demand by Government whenever the Principal shall fail to make payment as required in Sec. 3(c).

(c) If Purchaser elects to cut timber before payment of the second or subsequent installments, Purchaser shall increase the amount of the required performance bond by an amount equal to one or more installments, as set forth in Sec. 3(b). The adjusted bond must be approved, in writing, by the Authorized Officer prior to cutting any timber under the adjusted bond. The increased amount of bond shall be used to assure payment for such timber. Timber cut pursuant to this subsection may be paid for in installments. Upon payments, the increased amount of bond may be applied to other timber sold under this contract to permit its cutting in advance of payment.

(d) As contract provisions are completed to the satisfaction of the Authorized Officer, he may, in his discretion, reduce amount of performance bond required, *Provided, however*, the performance bond may not be reduced below the amount of two hundred fifty-two thousand, eight hundred and no/100------ dollars ($252,800.00) until total purchase price has been paid. The performance bond shall be forfeited to the amount of damages, determined by the Authorized Officer if all contract provisions are not faithfully and fully performed by Purchaser. If the amount of damages exceeds the amount of the bond, Purchaser hereby agrees to pay the excess. Upon satisfactory performance of all provisions of this contract, the bond shall be cancelled or, if cash or negotiable securities are furnished in lieu of a performance bond, such cash or negotiable securities shall be returned to Purchaser. In event of litigation, any determination by the Authorized Officer as to the amount of damages will be subject to review by a court of competent jurisdiction.

(e) If Purchaser elects to: (1) cut and remove timber or (2) remove timber already cut which has been secured by an increased performance bond as provided in Sec. 38(c), before payment of the second or subsequent installments, Purchaser shall obtain a payment bond in an amount equal to one or more installments as set forth in Sec. 3(b). The payment bond must be approved, in writing, by the Authorized Officer prior to cutting or removing any timber under the bond. The amount of the bond shall be used to assure payment for such timber, *Provided, however*, that such bond shall be considered as payment under Sec. 7, for the purpose of passing title and risk of loss to timber sold. Timber cut pursuant to this subsection shall be paid for as provided in Sec. 3(e). Upon payment, the amount of the bond may be applied to other timber to permit its cutting and/or removal in advance of payment. If a bond of a corporate surety is used, it shall provide that, if Purchaser fails to make payment as required by Sec. 3(e), the surety will make such payment including interest as specified in Sec. 3(h), to Government within sixty (60) days after demand by Government.

Sec. 39. *Time for Removal of Personal Property* — Purchaser shall have the right within two (2) months after expiration of time for cutting and removal to remove his equipment, improvements, or other personal property from Government lands or rights-of-way; *Provided, however*, that any improvements such as road surfacing, culverts and bridges which have become a permanent part of a Government road, shall not be removed. The Authorized Officer may, in his discretion, grant an extension of time, not to exceed three (3) months for removal of personal property. Any equipment, improvements, or other personal property remaining on Government lands and rights-of-way at the end of the period for removal, or any extension, shall become the property of Government.

Sec. 40. *Timber Reserved from Cutting* — The following timber on the contract area is hereby reserved from cutting and removal under the terms of this contract and is retained as the property of Government.

(A) All timber on the reserve areas shown on Exhibit A and all blazed, painted or posted trees which are on or mark the boundaries of reserve areas shown on Exhibit A.

(B) All timber in the partial cut area as shown on Exhibit A except approximately five thousand, one hundred ninety-four (5,194) trees which have been marked for cutting heretofore by the Government with blue paint above and below stump height.

(C) All timber except approximately fifty-eight (58) trees which have been marked for cutting heretofore by the Government with blue paint above and below stump height in the approximate area in which trees are marked for cutting in the reserve area shown on Exhibit A.

Sec. 41. *Special Provisions* — Purchaser shall comply with the special provisions which are attached hereto and made a part hereof unless otherwise authorized, in writing, by the Authorized Officer.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day first above written.

~~If Individual or Partnership, sign here:~~

(Name of Firm)

(Name)

(Address)

(Name)

(Address)

(Name)

(Address)

If Corporation, sign here:

The Robert Dollar Co.
(Name of Corporation)

R. Stanley Dollar Jr.
(Name)

PRESIDENT
(Title)

UNITED STATES OF AMERICA

By Sam J. Heaney
(Name)

District Manager
(Title)

APR 30 1974
(Date)

(If Purchaser is a corporation, the following certificate must be executed by the Secretary or Assistant Secretary of the Corporation)

I, R. P. SEELEY, certify that I am the Secretary of the corporation named as Purchaser herein; that R STANLEY DOLLAR, JR. who signed the contract was then PRESIDENT of said corporation, that said contract was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

[CORPORATE SEAL]

Appendix B

Dist.

SPECIAL PROVISIONS

(A) Logging Stipulations

(1) All timber sold to the Purchaser under the terms of this contract is restricted from export from the United States in the form of unprocessed timber. For the purpose of this contract, unprocessed timber is defined as (a) any logs, such as sawlogs, peeler logs, and pulp logs; (b) cants and squares to be subsequently remanufactured exceeding a nominal eight (8) inches in thickness; or (c) split or round bolts or other roundwood not processed to standards and specifications suitable for end product use.

In the event the Purchaser elects to sell any or all of the timber sold under this contract in the form of unprocessed timber, the Purchaser shall require each party buying, exchanging, or receiving such timber to execute a "Certificate as to Domestic Processing of Timber." The original of such certification shall be filed with the Authorized Officer.

Prior to the termination of this contract, the Purchaser shall submit to the Authorized Officer a "Log Scale and Disposition of Timber Removed Report" which shall be executed by the Purchaser. In addition, the Purchaser is required under the terms of this contract to retain for a three-year period from the date of termination of the contract, the records of all sales or transfer of logs involving timber from the sale for inspection and use of the Bureau of Land Management.

Unless otherwise authorized in writing by the Authorized Officer, the Purchaser shall prior to the removal of timber from the contract area, brand with the Purchaser's registered log brand at least one end of each log, bolt or other roundwood and identify each of these by painting with highway yellow paint.

In the event of the Purchaser's noncompliance with this subsection of the contract, the Authorized Officer may take appropriate action as set forth in Section 10 of this contract. In addition, the Purchaser may be declared ineligible to receive future awards of Government timber for a period of one year.

(2) The Government at its option may check scale any portion of the timber removed from the contract area. The Purchaser hereby agrees to make such contract timber available for scaling at a location designated by the Authorized Officer. In the event BLM elects to check scale and if such check scaling causes a delay in log transportation time, an adjustment will be made to the purchase price as follows. If the entire sale is check scaled, the purchase price of this contract shall be reduced by $4,627.01. In the event only a portion of the contract timber is scaled, the purchase price shall be reduced by that portion of $4,627.01 equal to the percentage of timber sold which was actually scaled by the Government. For purposes of computing this price reduction, the percentage of timber sold which has been scaled shall be determined by the Government. Any reduction in purchase price under the terms of this provision shall be full compensation to the Purchaser for any expense or loss incurred as a result of such scaling.

(3) Before beginning operations on the contract area for the first time or after a shutdown of seven (7) or more days, the Purchaser shall notify the Authorized Officer of the date he plans to begin operations. He shall also notify the Authorized Officer if he intends to cease operations for any period of seven (7) or more days.

(4) No tractor logging operations shall be conducted on the contract area between October 31 of one calendar year and April 15 of the following calendar year, both days inclusive.

(5) All snags, culls and marginal trees designated for cutting shall be felled concurrently with all other trees designated for cutting as shown on Exhibit A.

(6) In the partial cut area and the approximate area in which trees are marked for cutting in the Reserve Area shown on Exhibit A, yarding shall be done with crawler-type equipment without blades. Maximum width of the crawler equipment without blade shall be eight and one-half (8½) feet.

(7) In the special yarding area shown on Exhibit A, yarding shall be done with a slackline or skyline cable system utilizing a carriage.

(8) In the stream protection area shown on Exhibit A, all logs greater than six (6) inches in scaling diameter and longer than six (6) feet in length shall be removed from the stream channel and deposited at a point designated by the Authorized Officer. The removal of this material shall be done in concurrence with normal yarding operations and shall be done either by hand or with a slackline or skyline cable system.

(9) Prior to the commencement of operations, the Purchaser shall obtain from the Authorized Officer written approval of a written operations and logging plan commensurate with the terms and conditions of the contract which shall include measures needed to assure protection of the environment and watershed. All logging shall be done in accordance with the plan. Tractor- or wheeled-type equipment will not be permitted to operate in or through streams except under special conditions approved in the plan.

(B) Road Construction - Use - Maintenance - Improvement

(1) The Purchaser shall construct and improve the roads to the satisfaction of the Authorized Officer in a good and workmanlike manner, in conformity with law and in accordance with the location, plans and specifications listed in Exhibit C.

(2) Prior to removal of any timber, other than right-of-way timber, from the contract area, the Purchaser shall complete road improvement of Road No. 32-5-22 and #32-5-33.4 as indicated on Exhibits A and C.

(3) Road construction, and/or improvement, shall be completed to each subsale prior to removal of any timber, except right-of-way timber, from such area. All road construction shall be completed prior to removal of any timber, except right-of-way timber, from subsale E.

(4) The Purchaser is authorized to use the Murphy Road #32-5-22 and Roads #32-5-33.2\ and #32-5-33.4, shown on Exhibits A and C, which are under the jurisdiction of the Bureau of Land Management for the removal of Government timber sold under the terms of this contract; provided that, at all times during the period of his operations on the contract area, and upon completion of said operations, the Purchaser shall be liable for maintenance and repair of such roads resulting from wear or damage, except damage caused by major catastrophes or disasters resulting from Acts of God, flood, fire, war or riots, or wear or damage caused by third party users.

(5) Except for roads maintained in accordance with Section 16, the Purchaser shall perform road repair and maintenance work on all roads used by him under the terms of this contract as follows:

(a) Purchaser shall maintain the cross section of dirt or gravelled roads as presently existing or where applicable, to the reconstructed standards required by this contract, by blading and shaping the road surface and shoulders and by the placement of any required maintenance aggregate. Banks shall not be undercut. Established berms shall be maintained and additional berms shall be placed where needed to protect fills as directed by the Authorized Officer.

(b) Purchaser shall perform all road cleanup including removal of bank slough, slides and fallen timber, which can practicably be accomplished by a motor patrol grader equipped with a front-end blade, rubber-tired front-end bucket loader, or comparable equipment, and by the use of hand tools. When working conditions dictate end haul of material, the distance and the quantity of material required to be moved shall be limited to what is reasonable and practicable without the use of additional equipment.

Subject to such limitation, he shall also replace material eroded from fill slopes and clean out drainage ditches and culverts.

In removing material from slides or other sources, Purchaser shall deposit the material which must be moved at locations chosen with the objective that such material will not erode into streams, lakes or reservoirs, or cause undue damage to road fill slopes which have been planted or mulched to control soil erosion.

(c) Purchaser shall perform preventive maintenance at end of Purchaser's hauling each season and during nonhauling periods which occur between operations on the contract area to minimize weather damage to roads during the nonhauling period. This may include, but shall not be limited to, slide repairs, cross-ditching, post-hauling blading to remove ruts or other surface irregularities which would interfere with normal runoff of water and cleaning of ditches and culverts.

(d) While performing road maintenance work, Purchaser should avoid fouling gravel or bituminous surfaces through covering them with earth or debris from side ditches, slides, or other sources. Purchaser shall avoid blading surface material off surface of roads.

(e) Ice and snow removal from Bureau of Land Management roads is considered to be an extraordinary cost and not a part of normal maintenance. No snow or ice shall be removed from a Bureau-of-Land-Management-controlled road unless prior written approval has been secured from the District Manager. The Purchaser shall make his request for permission to remove ice or snow in writing at least four (4) working days in advance of the date operations are to begin.

The letter authorizing snow or ice removal will contain conditions and equipment requirements to be met by the Purchaser.

(f) The Purchaser shall perform the following specific maintenance:

Not later than June 30th of each summer that the contract is in effect, open the road sufficiently to permit the use of the road by firefighting equipment.

Remove, by blasting or digging, large rocks which protrude from the roadbed and interfere with blading. Holes in the road surface caused by such removal shall be filled with compacted fill material of the same type as the road surface.

(6) In the construction of the road across the S½NE¼, E½SE¼ Sec. 32, Township 32 South, Range 5 West, Will. Mer., as shown on Exhibit C, the Purchaser shall comply with the conditions of the Right-of-Way and Road Use Agreement M-887, dated November 17, 1969, between the United States of America and The Robert Dollar Co. available for inspection at the Bureau of Land Management, Medford District Office, 6th and Holly Streets, Medford, Oregon.

(7) In the construction of the road across the NW¼NE¼ Sec. 13, Township 32 South, Range 5 West, Will. Mer., as shown on Exhibit C, the Purchaser shall comply with the conditions of the Right-of-Way and Road Use Agreement M-824, dated December 20, 1966, between the United States of America and C & D Lumber Co., available for inspection at the Bureau of Land Management, Medford District Office, 6th and Holly Streets, Medford, Oregon. Prior to commencement of operations, the Purchaser shall furnish to the Authorized Officer a copy of the required executed License Agreement.

(C) Fire Prevention and Control

(1) Slash will be disposed of only in accordance with the written instructions of the Authorized Officer. Such instructions will require burying of right-of-way slash outside the road prism and piling or burying of slash at landings.

(2) Prior to construction or logging under this contract, the Purchaser shall prepare a fire prevention and fire control plan to the satisfaction of the Authorized Officer.

(D) Equal Opportunity in Employment

Certification of Nonsegregated Facilities attached hereto and made a part hereof.

Form 1140-3
(June 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

EQUAL OPPORTUNITY IN EMPLOYMENT CERTIFICATION OF NONSEGREGATED FACILITIES

Bid, offer or contract number or other identification:

36110-TS4-60

By the submission of this bid or offer and/or by entering into this contract, the bidder, offeror, lessee, subcontractor, or applicant certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means, but is not limited to, any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

In accordance with 41 CFR 60, as amended May 19, 1967, and Executive Order No. 11246 of September 24, 1965, as amended, this certification is applicable to all bids, offers, contracts and subcontracts as well as agreements with applicants who are themselves performing federally assisted contracts, which may exceed $10,000 and are not exempt from the provisions of the Equal Opportunity clause of the Order.

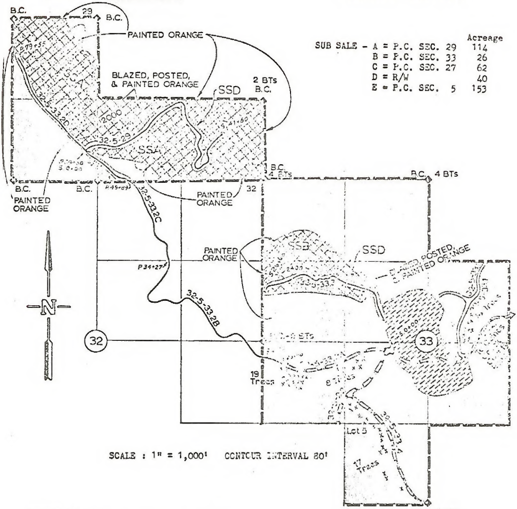
GPO 851-053

U.S.D.I. BLM MEDFORD DISTRICT SALE NO. 74-36. TIMBER SALE CONTRACT MAP

T. 32S., R.5W., SEC. 27, 29, 33.
T. 33S., R5W., SEC. 5 WILL MER CONTRACT NO. 36110 - TS4 - 60

SALE NAME: WOODFORD CREEK EXHIBIT A PAGE 1 OF 3

SUB SALE		Acreage
A	= P.C. SEC. 29	114
B	= P.C. SEC. 33	26
C	= P.C. SEC. 27	62
D	= R/W	40
E	= P.C. SEC. 5	153



SCALE : 1" = 1,000' CONTOUR INTERVAL 80'

▭ R/W AREA .... 40 Ac.

▒ RESERVE AREA .... 606 Ac.

▨ PARTIAL CUT AREA ...... 355 Ac.

▭ APPROX. AREA IN WHICH NO TREES ARE MARKED FOR CUTTING IN THE PARTIAL CUT AREA (15 Ac.)

xxxx APPROX. AREA IN WHICH TREES ARE MARKED FOR CUTTING IN THE RESERVE AREA.

▨ SPECIAL YARDING AREA. (320 Ac.)

▨ PREVIOUS SALE AREA. (RESERVE)

TOTAL CONTRACT AREA 1001 Ac.

═══ EXISTING ROAD.

═══ ROAD TO BE IMPROVED.

─── ROAD TO BE CONSTRUCTED.

◆ FOUND CORNERS.

— — — BOUNDARY OF CONTRACT AREA.

─── BOUNDARY OF CUTTING AREA.

+++++ STREAM PROTECTION AREA.

Appendix B

U.S.D.I. BLM MEDFORD DISTRICT SALE NO. 74-36.

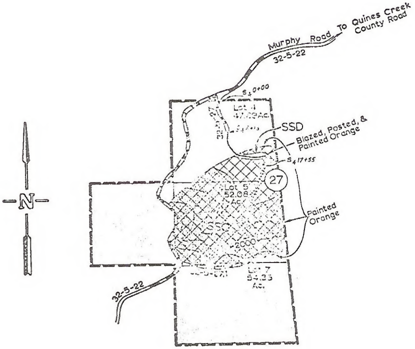
TIMBER SALE CONTRACT MAP.

T.32S., R.5W., SEC. 27, 29, 33
T.33S., R5W. SEC. 5. WILL MER

CONTRACT NO. 36110 - TS4-60

SALE NAME: WOODFORD CREEK.

EXHIBIT A PAGE 2 OF 3

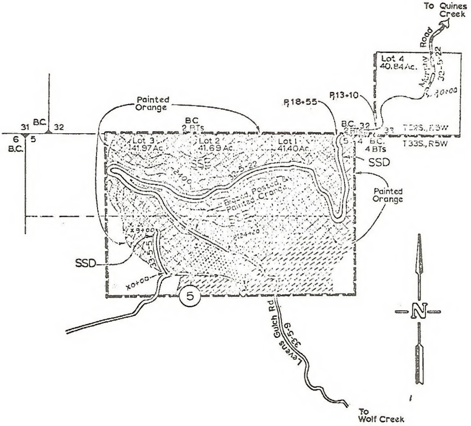


SEE PAGE ONE FOR LEGEND.

Appendix B

U.S.D.I. BLM MEDFORD DISTRICT SALE NO. 74-36.
T.32S., R5W., SEC. 27, 29, 33
T.33S., R5W., SEC. 5, WILL MER
SALE NAME: WOODFORD CREEK.

TIMBER SALE CONTRACT MAP.
CONTRACT NO. 36110 - TS4-60
EXHIBIT A PAGE 3 OF 3



SEE PAGE ONE FOR LEGEND.

Appendix B

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT EXHIBIT B LUMP SUM SALE	Contract No. 36110-TS4-60

The following estimates and calculations of value of timber sold are made solely as an administrative aid for determining: (1) adjustments made or credits given in accordance with Secs. 6, 9, or 11; (2) when payments are due; and (3) value of timber subject to any special bonding provisions. Except as provided in Sec. 2, Purchaser shall be liable for total purchase price even though quantity of timber actually cut or removed or designated for taking is less than the estimated volume or quantity shown. Cutting areas are shown on Exhibit A.

SPECIES	ESTIMATED VOLUME OR QUANTITY *(Units Specified)*	PRICE PER UNIT	AMOUNT OF ESTIMATED VOLUME OR QUANTITY × UNIT PRICE
Douglas-fir	7,554 M bd. ft.	$163.00	$1,231,302.00
Ponderosa Pine	23 M bd. ft.	116.55	2,680.65
White Fir	113 M bd. ft.	40.40	4,565.20
Western Hemlock	19 M bd. ft.	63.00	1,197.00
Incense-cedar	324 M bd. ft.	74.10	24,008.40
TOTALS	8,033 M bd. ft.		$1,263,753.25

The apportionment of the total purchase price is as follows:

Subsale A			
Douglas-fir	1,664 M bd. ft.	$163.00	$271,232.00
Ponderosa Pine	14 M bd. ft.	116.55	1,631.70
White Fir	27 M bd. ft.	40.40	1,090.80
Incense-cedar	88 M bd. ft.	74.10	6,520.80
	1,793 M bd. ft.		$280,475.30 ÷ 114 acres= $2,460.31 value per acre
Subsale B			
Douglas-fir	646 M bd. ft.	$163.00	$105,298.00
White Fir	18 M bd. ft.	40.40	727.20
	664 M bd. ft.		$106,025.20 ÷ 26 acres = $4,077.89 value per acre
Subsale C			
Douglas-fir	781 M bd. ft.	$163.00	$127,303.00
White Fir	22 M bd. ft.	40.40	888.80
Incense-cedar	54 M bd. ft.	74.10	4,001.40
	857 M bd. ft.		$132,193.20 ÷ 62 acres = $2,132.15 value per acre
Subsale D			
Douglas-fir	1,033 M bd. ft.	$163.00	$168,379.00
Ponderosa Pine	9 M bd. ft.	116.55	1,048.95
Western Hemlock	19 M bd. ft.	63.00	1,197.00
Incense-cedar	9 M bd. ft.	74.10	666.90
	1,070 M bd. ft.		$171,291.85 ÷ 40 acres = $4,282.30 value per acre
Subsale E			
Douglas-fir	3,430 M bd. ft.	$163.00	$559,090.00
White Fir	46 M bd. ft.	40.40	1,858.40
Incense-cedar	173 M bd. ft.	74.10	12,819.30
	3,649 M bd. ft.		$573,767.70 ÷ 153 acres = $3,750.12 value per acre

Appendix B

EXHIBIT C
Sheet 1 of 35

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TIMBER SALE ROAD PLANS AND SPECIFICATIONS

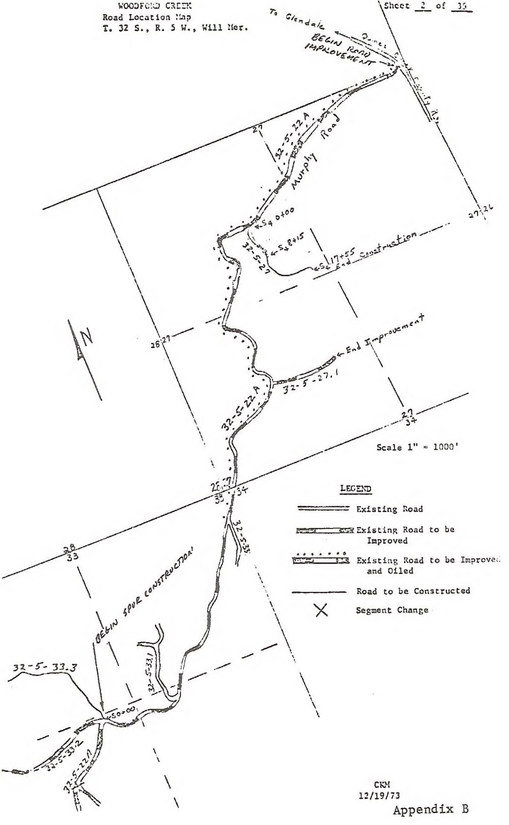
Woodford Creek Timber Sale

SPECIFICATION	SHEET NO.	SUBJECT
	2 & 3	Road Location Map
	4 & 5	Specification Sheet
	6-17	Plan and Profile
	18	Culvert List
100	19	General
200	20	Clearing and Grubbing
300	21	Grading
400	22	Corrugated Metal Culvert Pipe
600	23	Select Borrow Surfacing
900	24	Watering
1000	25	Renovation of Existing Roads
1300	26 & 27	Oil Dust Palliatives
	28	Special Provisions
	29	Rock Quarry Specifications
	30-31-32	Guide for use of Slope Stake Information
	33	Half-Round Culvert Installation
	34	Cross Drain Culvert Installation
	35	Water Dip Specifications

Appendix B

WOODFORD CREEK
Road Location Map
T. 32 S., R. 5 W., Will Mer.

EXHIBIT C
Sheet 2 of 35

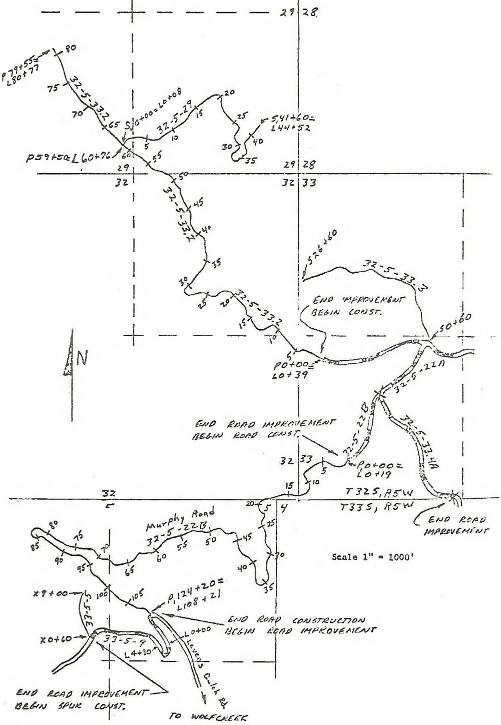


CKM
12/19/73

Appendix B

WOODFORD CREEK
Road Location Map
T. 32 S., R. 5 W.
T. 33 S., R. 5 W.

EXHIBIT C
Sheet 3 of 35



CKi
12/19/73

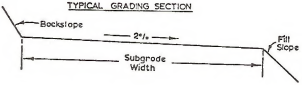
Appendix B

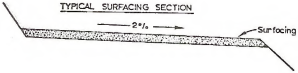
0-11-9110-26
Nov 1973

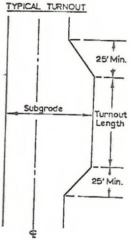
OUTSLOPE SPECIFICATION SHEET FOR UNDESIGNED SURFACED ROADS

EXHIBIT C
Sheet 4 of 35

Road No. 32-5-27 ~~Station~~ 32-5-29 ~~to Station~~ 32-5-33.3
Road No. 32-5-27.1 Station 33-5-5 ~~to Station~~ 32-5-33.2(L60+76
Road No. 32-5-2213 ~~Station~~ 33-5-9 ~~to Station~~ to L80+77)







	Rd. No.	Rd. No.	Rd. No.
	See above Road No.		
1. Road Standard	SN-16		
2. Alignment			
Max. degree of curve	80°	°	°
3. Road Width			
Subgrade	16 ft.	ft.	ft.
Turnout	26 ft.	ft.	ft.
4. Gradient			
Max. Favorable	15 %	%	%
Max. Adverse	12 %	%	%
5. Clearing Width			
Beyond Top of Cut	0 ft.	ft.	ft.
Beyond Toe of Fill	5 ft.	ft.	ft.
6. Surfacing			
Min. Width	12ft.	ft.	ft.
Top Course	ft.	ft.	ft.
Base Course	ft.	ft.	ft.
Select borrow rock			
Compacted depth	8 in.	in.	in.
Crushed Base Rock			
Grading			
Compacted depth	in	in	in
Crushed surface rock			
Grading			
Compacted depth	in	in	in.
7. Turnouts			
Length	75 ft.	ft.	ft.

Width - 10 ft. in addition to subgrade width, located approximately as shown on the Road Location Map, and intervisible.
Surfacing - 10 feet in addition to min. surface widths.

8. Drainage
Culverts - corrugated sheetmetal
Standard round 18 in. min. diam.
Other Water dips

9.

Grading	Back Slopes	Fill Slopes
Common	1/2 : 1	1½:1
Soft rock and shale	½:1	1 1/3:1
Solid rock	¼:1	Angle of repose

10. Extra subgrade widths
Add to each fill shoulder 1 ft. for fills 1-6 ft., 2 ft. for fills over 6 ft

Widen the inside shoulder of all curves as follows:

When degree of curve equals
7° - 21° - 1 ft
22° - 35° - 2 ft
36° - 48° - 3 ft
49° - 64° - 4 ft
65° - 80° - 5 ft

11. Full bench construction required on sideslopes exceeding 60%.

0-11-9110-2
Mar. 1970

CULVERT LIST

EXHIBIT C
Sheet 18 of 35

Woodford Creek Timber Sale

Station	Diameter	Length	Skew	1/2 Round	Gage	Remarks
Road #32-5-33.						
L 2+59	18"	56'			16	
L 3+95	18"	33'			16	
L 7+67	18"	54'			16	
L 10+44	18"	60'			16	
L 14+45	18"	40'	30°		16	
L 17+16	18"	66'			16	
L 19+33	18"	92'			16	
L 22+42	18"	42'	30°		16	
L 33+23	18"	36'	30°	21"x20'	16	
L 38+25	18"	52'		21"x20'	16	
L 43+24	18"	40'		21"x20'	16	
L 50+80	18"	36'		21"x30'	16	
L 56+90	18"	48'	30°	21" x 20'	16	
L 60+76	18"	38'	30°		16	
Road # 32-5-27						
S₄ 4+02	18"	36'			16	
S₄ 10+30	18"	32'			16	
S₄ 12+30	18"	32'			16	
Road # 32-5-33.B						
S 19+70	18"	32'		21" x 10'	16	
Road # 32-5-29						
L 38+69	18"	74'			16	
Road #32-5-22.B						
L 1+87	18"	30'			16	Extension on existing
L 12 60	48"	46'			12	CMP
L 16+11	18"	48'			16	
L 66+08	18"	32'	30°		16	
Totals	18"	1014'				
	48"	46'				
	21"	110' Half round				

Appendix B

Exhibit C
Sheet 19 of 35

ROAD SPECIFICATIONS

GENERAL - 100

101 - Definitions

Roadbed - At any particular stage of construction, the portion of a road between the intersections of side slopes and top.

Roadway - The portion of the road within limits of construction.,

Spalls - Flakes or chips of stone.

102 - When any work is to be specifically tested or approved, the Purchaser shall give the Authorized Officer timely notice of its readiness for inspection and of the date fixed for such inspection. The Authorized Officer will not unreasonably delay response to requests for inspection and approval. Written approval shall be required for all work to be tested or approved.

SPECIAL PROVISIONS

Select Borrow Surfacing

All surfacing will be processed through a rock crushing machine consisting of a jaw and cone, or equivalent, to assure reduction of all material to a maximum size of 2½" in its greatest dimension.

Oiling

Dust oil shall be applied on Road 32-5-22A between County Road and the saddle in Section 33 according to specifications shown on sheet 26 and 27 of Exhibit C.

Right-of-Way Slash Removal

All right-of-way slash shall be buried outside the road prism limits in areas designated by the Authorized Officer.

Restrictive Time for Installation of Culvert

Installation of the culvert at stations L 3+12, L 12+60 on Road #32-5-22B will be done between June 15 and October 1 of the same year.

Waste Material

All waste material from L 7+50 to L 18+00 on Road #32-5-29 shall be end hauled to a designated area as directed by the BLM Authorized Officer shown on sheet 8 of Exhibit C.

EXHIBIT C
Sheet 29 of 35

ROCK QUARRY SPECIFICATIONS

1. GENERAL

The Purchaser shall notify the Authorized Officer at least four (4) days prior to commencing quarry operations.

All local, state and Federal safety codes concerning quarrying operations, warning signs and traffic control shall be complied with.

If the Purchaser desires to use a rock source other than the designated source, he shall collect rock samples as described by the Authorized Officer and have them tested at an approved laboratory and complete a written quarry exploration, development and reclamation plan. The Purchaser shall obtain from the Authorized Officer written approval of test results and plans prior to the commencement of quarry exploration. All such activity shall be done in accordance with the plan.

A chemical toilet shall be placed at the quarry site prior to commencing operations and shall be maintained until crushing operations are complete.

2. QUARRY DEVELOPMENT

The quarry shall be developed in a manner which will provide access to the total estimated future volume of rock which will be removed from the site.

All material blasted or dislodged from the quarry walls shall be utilized or disposed of as directed by the Authorized Officer. If necessary, secondary blasting or other means shall be employed to reduce the quarried rock to a usable size.

All quarries or pits shall be excavated in benches. The bench sections shall not be greater than forty (40) feet in height and not less than twenty (20) feet in width.

3. DISPOSAL OF OVERBURDEN AND OTHER MATERIAL

Overburden, trees, stumps and logs shall be removed back from the edge of all working quarry faces for a distance of twenty (20) feet.

Overburden and/or reject material shall be piled in orderly piles as directed.

4. PIT CLEANUP

Upon completion of quarry operations, the quarry site shall be graded and shaped.

The quarry shall be drained by placement of outsloping as shown in the quarry development plan.

Exhibit C
Sheet 30 of 35

PURCHASER SLOPE STAKING

GENERAL

The Purchaser shall slope stake Roads No. 32-5-22B, 32-5-33.2, 32-5-29 and 33-5-9 (see sheets 6-14 and sheet 17) in accordance with the slope stake information furnished by the authorized officer and the following provisions.

Slope staking shall be completed in time to allow an adequate period for checking. The Purchaser shall submit a copy of the slope stake notes prior to approval. The completed staking must be approved in writing by the Authorized Officer prior to construction.

SLOPE STAKES

A slope stake shall be set on the cut side of the road or on the uphill side of a fill section.

In through cuts exceeding 15 feet in depth at centerline, both sides of the road shall be staked.

Stakes shall be set at a maximum interval of 80 feet on tangents and 50 feet on curves.

The slope stake shall be moved back to the reference stake location at time of staking. Slope stakes shall be of good quality and flagged with red ribbon.

REFERENCE STAKES

A reference stake or aluminum tag shall be set for each slope stake and shall be nailed to the base of a stump or tree whenever practicable. The stake shall be placed outside the posted right-of-way or outside the expected construction zone if the right-of-way is not posted.

GENERAL PROVISIONS

Slope stakes and reference stakes shall be set and marked according to the illustrations included in the exhibit on pages 31 & 32.

Slope and reference stakes shall be set to conform to the following standards of accuracy:

a. Maximum horizontal deviation from centerline ± 0.5 feet.

b. Maximum vertical deviation from centerline grade ± 0.5 feet.

The Purchaser shall provide all materials necessary to complete the project.

(Public -No. 405-75th Congress)
(Chapter 876-1st Session)
(H.R. 7618)

AN ACT

Relating to the Revested Oregon and California Railroad and reconveyed Coos Bay Wagon Road grant lands situated in the State of Oregon.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That notwithstanding any provisions in the Acts of June 9, 1916 (39 Stat. 218), and February 26, 1919, (40, Stat. 1179), as amended, such portions of the revested Oregon and California Railroad and reconveyed Coos Bay Wagon Road grant lands as are or may hereafter come under the jurisdiction of the Department of the Interior, which have heretofore or may hereafter be classified as timberlands, and power-site lands valuable for timber, shall be managed, except as provided in Section 3 hereof, for permanent forest production, and the timber thereon shall be sold, cut, and removed in conformity with the principal of sustained yield for the purpose of providing a permanent source of timber supply, protecting watersheds, regulating stream flow, and contributing to the economic stability of local communities and industries, and providing recreational facilities: Provided, That nothing herein shall be construed to interfere with the use and development of power sites as may be authorized by law.

The annual productive capacity for such lands shall be determined and declared as promptly as possible after the passage of this Act, but until such determination and declaration are made the average annual cut therefrom shall not exceed one-half billion feet board measure: Provided, That timber from said lands in an amount not less than one-half billion feet board measure, or not less than the annual sustained yield capacity when the same has been determined and declared, shall be sold annually or so much thereof as can be sold at reasonable prices on a normal market.

If the Secretary of the Interior determines that such action will facilitate sustained-yield management, he may subdivide such revested lands into sustained-yield forest units, the boundary lines of which shall be so established that a forest unit will provide, insofar as practicable, a permanent source of raw materials for the support of dependent communities and local industries of the region; but until such subdivision is made the land shall be treated as a single unit in applying the principle of sustained yield; Provided, That before the boundary lines of such forest units are established, the Department, after published notice thereof, shall hold a hearing thereon in the vicinity of such lands open to attendance of State and local officers, representatives of dependent industries, residents, and other persons interested in the use of such lands. Due consideration shall be given to established lumbering operations in subdividing such lands when necessary to protect the economic stability of dependent communities. Timber sales from a forest unit shall be limited to the productive capacity of such unit and the Secretary is authorized, in his discretion, to reject any bids which may interfere with the sustained-yield management plan of any unit.

Sec. 2. The Secretary of the Interior is authorized, in his discretion, to make cooperative agreements with other Federal or State forest administrative agencies or with private forest owners or operators for the coordinated administration, with respect to time, rate, method of cutting, and sustained yield, of forest units comprising parts of revested or reconveyed lands, together with lands in private ownership or under the administration of other public agencies, when by such agreements he may be aided in accomplishing the purposes hereindefore mentioned.

Sec. 3. The Secretary of the Interior is authorized to classify, either on application or otherwise, and restore to homestead entry, or purchase under the provisions of section 14 of the Act of June 28, 1934, (48 Stat. 1269), any of such revested or reconveyed land which, in his judgment, is more suitable for agricultural use than for afforestation, reforestation, stream-flow protection, recreation, or other public purposes.

Any of said lands heretofore classified as agricultural may be reclassified as timber lands, if found, upon examination, to be more suitable for the production of trees than agricultural use, such reclassified timber lands to be managed for permanent forest production as herein provided.

Sec. 4. The Secretary of the Interior is authorized, in his discretion, to lease for grazing any of said revested or reconveyed lands which may be so used without interfering with the production of timber or other purposes of this Act as stated in section 1: Provided, That all the moneys received on account of grazing leases shall be covered either into the "Oregon and California land-grant fund" or the "Coos Bay Wagon Road grant fund" in the Treasury as the location of the leased lands shall determine, and be subject to distribution as other moneys in such funds: Provided further, That the Secretary is also authorized to formulate rules and regulations for the use, protection, improvement, and rehabilitation of such grazing lands.

Sec. 5. The Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this Act into full force and effect. The Secretary of the Interior is further authorized, in formulating forest-practice rules and regulations, to consult with the Oregon State Board of Forestry, representatives of timber owners and operators on or contiguous to said revested and reconveyed lands, and other persons or agencies interested in the use of such lands.

In formulating regulations for the protection of such timberlands against fire, the Secretary is authorized, in his discretion, to consult and advise with Federal, State, and county agencies engaged in forest-fire-protection work, and to make agreements with such agencies for the cooperative administration of fire regulations therein: Provided, That rules and regulations for the protection of the revested lands from fire shall conform with the requirements and practices of the State of Oregon insofar as the same are consistent with the interests of the United States.

TITLE II

That on and after March 1, 1938, all moneys deposited in the Treasury of the United States in the special fund designated the "Oregon and California land-grant fund" shall be distributed annually as follows:

(a) Fifty per centum to the counties in which the lands revested under the Act of June 9, 1916 (39 Stat. 218), are situated, to be payable on or after June 30, 1938, and each year thereafter to each of said counties in the proportion that the total assessed value of the Oregon and California grant lands in each of said counties for the year 1915 bears to the total assessed value of all of said lands in the State of Oregon for said year, such moneys to be used as other county funds.

(b) Twenty-five per centum to said counties as money in lieu of taxes accrued or which shall accrue to them prior to March 1, 1938, under the provisions of the Act of July 13, 1926 (44 Stat. 915), and which taxes are unpaid on said date, such moneys to be paid to said counties severally by the Secretary of the Treasury of the United States, upon certification by the Secretary of the Interior, until such tax indebtedness as shall have accrued prior to March 1, 1938, is extinguished.

From and after payment of the above accrued taxes said 25 per centum shall be accredited annually to the general fund in the Treasury of the United States until all reimbursable charges against the Oregon and California land-grant fund owing to the general fund in the Treasury have been paid: Provided, That if for any year after the extinguishment of the tax indebtedness accruing to the counties prior to March 1, 1938, under the provisions of Forty-fourth Statutes, page 915, the total amount payable under subsection (a) of this title is less than 78 per centum of the aggregate amount of tax claims which accrued to said counties under said Act for the year 1934, there shall be additionally payable for such year such portion of said 25 per centum (but not in excess of three-fifths of said 25 per centum), as may be necessary to make up the deficiency. When the general fund in the Treasury has been fully reimbursed for the expenditures which were made charges against the Oregon and California land-grant fund said 25 per centum shall be paid annually, on or after June 30, to the several counties in the manner provided in subsection (a) hereof.

(c) Twenty-five per centum to be available for the administration of this Act, in such annual amounts as the Congress shall from time to time determine. Any part of such per centum not used for administrative purposes shall be covered into the general fund of the Treasury of the United States: Provided, That moneys covered into the Treasury in such manner shall be used to satisfy the reimbursable charges against the Oregon and California land-grant fund mentioned in subsection (b) so long as any such charges shall exist.

All Acts or parts of Acts in conflict with this Act are hereby repealed to the extent necessary to give full force and effect to this Act.

Approved, August 28, 1937.

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

Addendum to Timber Management Draft E.I.S. - DES 75-10

Due to some errors in printing the enclosed pages may have been omitted in your copy of the draft statement.

(2) Biological Control. This involves the use of living organisms which are either collected in an area where they are abundant or propagated under confinement and then released from the air or ground in the infested area. These organisms can be classified as:

- Parasites -- usually the young life forms of certain wasp and fly families.
- Predators -- such as lacewing flies, certain beetles, birds and mammals.
- Diseases -- caused by many different micro-organisms, including viruses, bacteria and fungi.

While the use of biological control methods have had some spectacular results with agricultural crop pests, their application in combatting forest pests have not been outstandingly successful.[11] Consequently, the use of this control measure is not currently planned for the near future.

(3) Chemical Control. This method involves the use of chemicals which kill the insect by suffocation or through entry via the body wall, digestive tract or respiratory system. Insecticides are classified as:

- Inorganic -- containing elements such as arsenic, fluorine, mercury, copper or zinc.
- Botanical -- such as rotenone, nicotine and pyrethrum.

- Synthetic Organic - includes the chlorinated hydrocarbons such as methoxychlor.
- Mineral Organic -- includes kerosene, fuel oil and lubricating oil which along with water are often also used as carriers for the other insecticides.

These insecticides are applied to trees in a number of ways, the choice being dependent upon the insect involved, the insecticide used and its formulation and the equipment available. The most common method, particularly in combatting defoliating insects, is spraying or dusting from an aircraft since it can be applied rapidly to large forested areas inaccessible from the ground. Ground methods include hydraulic spraying equipment mounted on vehicles and hand-operated units, are used when total coverage of the tree or log is necessary. Mist blowers, consisting of an engine-powered fan, can also be utilized as a mobile ground unit to disseminate insecticides. Another method, used primarily for bark beetles, involves the injection of chemicals into the sapstream of a tree which are then taken up through the trunk causing mortality to the beetles in the inner bark.

Approximately 2,000 acres in Oregon, Washington and Idaho were treated in 1974 with DDT to control an extensive Tussock Moth infestation. No further chemical control methods are currently planned for this insect or others.

- Maintaining stands in healthy and vigorous condition by regulating composition, density and age.

(2) Direct Physical Control. This method employs the use of physical or mechanical means to control existing disease infestations and to recover marketable material, when applicable. Direct control practices currently being used are almost completely limited to dwarf mistletoe control and are usually carried out by use of silvicultural practices. Dependent upon the degree of infestation, stand composition, tree size and other variables, either of the two following general approaches may be taken:

- Complete removal of all trees on and immediately adjacent to the infested area by cutting, burning or poisoning. Marketable material to be utilized.
- Removal and/or pruning of infected trees through precommercial thinning, commercial thinning or other partial cutting operations. Consists largely of discriminating against infected trees or disease prone species in selecting trees to be cut in the course of standard silvicultural practices.

3. Harvest

Harvest is the final phase of the timber production cycle and the first phase of the utilization cycle which represents the conversion of standing trees into forms useful to the human economy and arts. The steps associated with these phases of the production or utilization cycles include the felling of marketable timber according

to selected cutting practices, the movement of logs or trees from stump to loading points by use of logging systems, and their subsequent movement over transportation systems to manufacturing centers. Each of these three steps, which include final harvest, mortality salvage and commercial thinning operations, are closely related, however, they will be described separately in the parts that follow.

a. Cutting Practices

The selection of the appropriate cutting practice is basically a matter of silvicultural desirability, i.e., a certain practice, or combination of practices, is applied to a given timber stand in order to favor regeneration and/or promote growth. An exception is the emergency situation, in which trees killed or damaged by fire, insects, disease or weather are promptly removed by an unscheduled salvage cutting. Factors to be weighed in selecting the cutting practice include species composition; stand age, stocking and condition (as related to tree vigor and risk of mortality); site quality and regenerative capacity; fire and insect hazards which may be created by logging slash; topography; and anticipated effects of weather conditions on the residual stand. Consequently, because of diverse nature of conditions within a given forest a variety of cutting practices is followed. Once the cutting practice(s) is chosen, those trees designated for cutting and/or trees reserved from cutting are identified on the timber harvest area.

Cutting practices have been classified by different authorities in various ways; e.g., as silvicultural systems for

clearcutting to remove sources that would infect young trees in the new forest. Approximately 17,500 acres will be clearcut each year in northwestern Oregon. Additionally, 1,500 acre will be clearcut in southwestern Oregon and about 800 acres in the remaining forests on an annual basis.

(b) Seed-tree Cutting. Removal of the mature timber in one cut, except for seed trees (reserved for stand regeneration) left singly or in small groups.[22] These seed trees may be subsequently cut when the area is reforested. The application of this practice has been limited to less than several hundred acres a year, as an experiment in Tillamook, Oregon, and operationally in Montana.

(c) Selection Cutting. Removal of mature timber, usually the oldest or largest trees, either as individual trees or in small groups at relatively short intervals, commonly 5 to 20 years, repeated indefinitely by means of which the continuous establishment of natural reproduction is encouraged and an uneven-aged stand is maintained.[23] This practice will be limited to the relatively small acreage of pure Ponderosa Pine stands found on Bureau administered lands.

(d) Shelterwood Removal Cuttings. These represent the third and final phase in a series of shelterwood cuttings as previously described under intermediate cuttings. They remove the remainder of the mature stand which, after establishment of reproduction, retards the development of young trees. The final cutting is the last of the removal cuttings.[24] Like the second cut or seed cut of the shelterwood system, very little acreage will be subjected to the removal cut during this decade since the preponderance of mature timber has not been subjected to any cutting to date.

b. Logging Systems

The movement of felled timber to the loading point (landing) is accomplished through the use of a single system or combination of logging systems best suited for the area to be harvested. The selection is based on criteria which include:

- The physical requirements and capabilities of the applicable logging systems.
- The most economical combination of yarding costs, road construction costs, and major transportation costs.
- Silvicultural systems and cutting practices to be employed, and the priority sequence of harvesting.
- Protection of the reserve timber stand and preservation of soil and water sources.
- The safety of the men engaged in all phases of the harvesting operation.

While outside the scope of logging systems, the cutting or falling of trees and bucking them into tree or log lengths require some mention at this point. These operations are a prerequisite to their movement and constitute a major part of the logging operation. Trees are normally felled in a manner so as to minimize loss due to breakage as well as to minimize damage to the residual trees or adjacent stands. Beds are sometimes prepared to reduce breakage when very large trees are cut. In addition to topographical criteria, the system of logging to be employed is a factor in the manner and direction in which the trees are felled. In both the falling and bucking operation

Rigged for use, the power source (yarder) is located at the landing near a vertical spar usually 80 to 120 feet tall. As a turn of logs is yarded by the mainline cable toward the landings, they are dragged full length along the ground unless a stump or other obstacle is encountered. Then the vertical component of force on the mainline lifts the front end of the log until it noses over or around the obstacle. Consequently, the high-lead system operates most smoothly and efficiently when yarding uphill. Downhill yarding is feasible, but logs tend to "hang-up" on obstacles and dig into the ground. When all logs within reach of the mainline are at the landing it is moved laterally. The process is repeated in radial fashion, with the spar as a hub, until all desired logs in the setting have been moved to the landing.

The high-lead system is best adapted to yarding clearcut settings uphill, with maximum yarding distance of about 800 feet as optimum, although long "reaches" are possible. With careful operation by a skilled crew, the system can also be used for logging such partial cuts as sanitation-salvage, shelterwood and selection cuttings. High lead yarding will continue to be used on almost one third of the acreage to be harvested and will be used primarily in northwest Oregon.

(d) Mobile Yarder-Loader Operations [25, 26]

Various methods of yarding are employed in situations where neither high-lead nor tractor logging is practical. The mobile yarder-loader

is particularly adapted to removing small total volumes of timber, to operating in stands of low volume per acres, or in small timber on steep terrain.

While there are several variations of mobile yarder-loaders, they have certain common characteristics:

- All are self-propelled, and can be driven from setting to setting (as opposed to most high-lead yarders).
- All are equipped with booms or spars which, when erected, provide lift for yarding and for loading trucks when lowered.
- Most have drum facilities which permit being used as high-lead systems.

Some of these machines can yard logs to a reach of 1,000 feet. However, under optimum conditions, usualy maximum yarding distance is about 500 feet. Since they operate on the high-lead principle, mobile yarder-loaders are most efficient when yarding uphill.

These machines are well-suited to logging commercial thinnings and sanitation-salvage, shelterwood and selection cuttings. A rather unique attribute is their capability of operating directly from an existing road, thus eliminating the necessity of clearing and excavating landings. As each small setting below the road is cleared of logs, which are merely piled or "decked" along the road shoulder, the machine is quickly moved a short distance along the road to its next setting. Mobile yarders represent the third leading logging method employed on Bureau administered forests and will continue to be used primarily in western Oregon.

- Slacklines ("live" skylines). Commonly operating on a reach of 1,200 to 1,600 feet or more, slacklines have capabilities and applications comparable to those of the smaller fixed skyline systems.
- Running Skylines. These are the most recently developed of the skyline systems. They are becoming widely used in the northwestern United States, and are replacing standing skylines and high-lead systems in some applications.[28] A past disadvantage of these systems has been a rather short span capability (reach) of about 1,000 feet. However, yarders with reaches exceeding 2,000 feet are now available.[29] The running skyline is particularly well-suited to yarding intermediate cuttings and harvest cuttings of a partial nature, where damage to trees left standing must be minimized. Properly equipped and utilized, running skylines may yard clear-cuttings as effectively as the high-lead.

(b) Balloon Yarding. Despite rather wide publicity, balloon logging has had only limited use to date. The few American balloon logging operations conducted to date have probably been economically marginal. Applications in coastal British Columbia have been more successful. Currently less than 100 acres a year have been balloon logged on Bureau administered forests in western Oregon. Balloon systems, which lift logs completely off the ground, have yarded for distances exceeding 5,000 feet, although 3,000 feet might be considered optimum.[30] Balloon systems are more expensive to operate than skylines because of additional cost of the balloon, its accessories, and gas for inflation.[31] Other disadvantages are

instability of the balloon in moderate to strong winds, adverse reactions of the balloon to temperature extremes, and gas leakage. The increased expense of balloon logging may be economically justified where terrain and limited road access preclude logging with other systems.

Presently, balloon yarding appears to be best adapted to clearcuttings because of the difficulty of controlling the balloon in side winds and resulting lateral movement of the butt rigging and its suspended turn of logs, which can damage reserved trees in a partial cut.[32] However, experience indicates that the balloon can be used successfully to remove the overstory of a two-storied stand.

(c) Helicopter Yarding. Helicopter logging applications are in the formative stages. The very high unit costs of yarding with helicopters are the primary factor now limiting the use of these machines. However, high performance helicopters capable of lifting maximum loads of 20,000 pounds are available for logging.

In a well-planned helicopter logging operation, the machine flies logs to a landing located at a lower elevation than the area being logged. The helicopter can yard uphill, but this significantly reduces its speed. One-way flight distances should range from 1300 to 8000 feet.[33] The logs are hooked to a tag line 100-200 feet in length which is suspended from the helicopter, which then climbs vertically to clear obstructions before moving toward the landing.

Areas to be partially or selectively logged can be yarded by helicopter in cases where the surrounding trees or

and maintenance phases and will be discussed on that basis in the following subsections.

(1) Construction. This phase includes all the practices followed from the initial entry of equipment on the road location site to its availability for log hauling. The construction phase involves the movement of a portion of the earth's surface from one location to another and in its new position, creation of a desired shape and physical condition which will serve the purpose for which the road is built. While roads are of varying standards and specifications the practices set forth are characteristic of those constructed on Bureau administered lands.

Basic construction operations are clearing and grubbing, excavation, formation of embankments, finishing and addition of bases and surfacing courses, and structures. Any or all of these operations may be performed on a given road project at the same time and may overlap to a certain extent.

(a) Clearing and Grubbing. Clearing refers to the removal of trees, brush, etc. from within the limits of the designated area along the road's location. Grubbing refers to the removal of roots, stumps and similar obstacles to a nominal depth below the existing ground area. Frequently, they comprise a single operation and include the removal of topsoil to a shallow depth. This practice is primarily performed by a bulldoxer to fell trees and uproot stumps, however, it may also involve the use of explosives and other equipment.

(b) Excavation.[35, 36] This practice refers to the removal of natural material from its resting place and transporting it to a different place through an earth moving operation. It normally constitutes the major part of the construction operation and, in addition to the road itself, is carried out in conjunction with the installation of such structures as culverts, drainage pipes and bridges. Excavation may be classified by the type of material excavated, as follows:

- Topsoil excavation is removal and stripping of the exposed layer of the earth's surface.
- Earth (or common) excavation is removal of the layer of soil under the topsoil and on top of rock. Earth can be broken down for ease of handling by plowing and ripping and is usually moved easily by scrapers or other types of earth moving equipment.
- Rock excavation is the breaking down of a formation by systematic drilling and dynamite blasting, for ease of removal by rock-hauling equipment.
- Muck excavation is removal of soil that contains an excessive amount of water. This material is usually unstable under loading, and undesirable as an embankment material.
- Unclassified excavation is done without regard to materials encountered and may be any combination of topsoil, earth, rock, and muck.

The equipment most widely used is excavating work is a wheel or track (crawler) type tractor with a steel blade that

Gravel roads which are untreated require a heavy blading of the surface and side ditches in early spring and late fall. Heavy rains may cause bad rutting and require the addition of gravel and additional blading. Road mix and macadam surfaces require patching of holes, ruts and unraveled areas and renewal of the surface periodically by application of a seal coat.

(b) Shoulder, Sideslope and Roadside Maintenance. This maintenance consists of erosion control, visibility protection and brush control. The erosion control is accomplished by seeding and mulching and other soil stabilization practices and the brush control is accomplished by cutting back (or chemically treating) weeds and brush which obscure visibility and interfere with drainage.

(c) Drainage Maintenance. This is accomplished by removing debris from culverts, correcting erosion by use of rock backfill, repairing eroded ditches with rock material and riprapping areas eroded by stream action. This also includes repairs to bridges and small structures.

(d) Safety Maintenance. This includes sanding icy sections, replacing signs and protective barriers in order to preserve safety features of the original construction, dust prevention by spreading oil or water, debris removal and some limited snow removal.

F. History of the Public Lands

The forest lands administered by the Bureau of Land Management fall into two principal categories: (1) the public domain lands extending throughout the Western United States, including Alaska, (2) the western Oregon lands composed primarily of the revested Oregon and California Railroad Grant Lands and the Reconveyed Coos Bay Wagon Road Lands, which together are usually referred to as the O&C lands. Since their legislative histories vary, each will be discussed individually in this section, however, they are to be collectively considered as public lands throughout the remainder of this statement. (Figs. 1 & 2)

1. Public Domain Lands

During the 100 years after the United States became a nation it was presented with an unparalleled opportunity for development through the acquisition of lands. Seven of the original states ceded parts of their territories to the Federal Government which generally included those lands between the original states and the Mississippi River. Following this, the acquisition of the lands between the Mississippi River and the Pacific Ocean and finally the acquisition of Alaska in 1867, provided the United States with a vast area of largely unsettled lands that in the main had not been committed to private ownership or use.[41]

The subsequent disposal of these lands to encourage settlement of the West was accomplished under the Homestead Act of 1862, and other authorities which resulted in the granting or selling of

approximately 1 billion acres to individuals, corporations and states. These lands were generally the most productive for resource and agriculture development and were located in the fertile valleys, plains, and low elevational areas. There were of course significant exceptions. Beginning just prior to 1900, the emphasis in public land policy began to shift toward the retention of some lands in Federal ownership. Millions of acres of land were set aside to be held as national forests, national parks, or other conservation and management units. The policy of reservation of lands for parks and forest, however, did not halt large scale disposals. Homesteading was still a means of transferring considerable Federal land into private ownership until the 1930's. But by this time most of the land suitable for farming under the existing conditions was in private ownership. The Taylor Grazing act of 1934 brought the era of homesteading largely to an end. The lands that remained in the unappropriated and unreserved public domain, outside of those in Alaska, were mainly in the arid and semi-arid areas of the West.[42]

Today, the public domain lands in Federal ownership together with additional areas of acquired lands total nearly 755 million acres; one third of the nation's land surface. Of this total, about 210 million acres of the public domain have been reserved as national parks and national forests, under the administration of the National Park Service and Forest Service respectively, and approximately 75 million acres set aside for other specific uses. The Bureau of Land Management is responsible for the administration of the 470 million

acres of the remaining public domain, representing over 60 percent of all Federal lands.[43] Approximately two-thirds of Bureau administered lands are in Alaska, a large portion of which are subject to disposal to satisfy state and native claims. Public domain forest lands under the jurisdiction of the Bureau total about 21 million acres, widely scattered, and are generally the residue left following the inclusion of the relatively higher valued forest lands in the National Forest system. The remaining public domain is primarily comprised of grasslands, desert, tundra, and woodlands scattered throughout the western United States.

2. Western Oregon Lands

The western Oregon lands are mostly the remainder of grants issued for approximately 4 million acres of public domain land in the latter part of the 19th Century to corporations for the purpose of providing incentives for the construction of railroads and wagon roads. The major grant was to the Oregon and California Railroad Company and included odd-numbered sections (640 acres in size) of public domain land in a strip 40 miles wide along a proposed railroad line extending from the Columbia River, near Portland, to the California line. Because some of the odd-numbered sections within this strip had already passed to state and private ownership, the company was given the right to select the odd-numbered sections in a strip 10 miles wide on each side of the original strip. Another railroad grant was made to the Oregon Central Railroad Company, later absorbed by the Oregon and California Railroad Company, for alternate sections in a 40-mile wide

Bureau of Land Management
Library
Denver Service Center

R'S CARD
T58 1975
mental
r timber

OFFICE	DATE RETURNED

(Continued on reverse)

SD 538.2 .A17 T58 1975

Draft environmental
statement for timber

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225